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Dual Practice in Developing Country Health System

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Chapter 1

Introduction

This thesis focuses on dual practice by physicians, using a developing country setting and providing both theoretical analysis and empirical evidences. The term of “dual practice physician” in this research refers to physicians who work in public health care facility owned by government and at the same time also engaged in private practice. A dual practice activity among physicians is a common practice particularly in developing countries. From a general perspective, allowing physicians in dual practice activity by government has the purpose to provide more health care access under low ratio of health care personnel. This practice is usually adopted in developing countries to increase health care utilization and promote the using of formal health care, as many people still rely on self-treatments or traditional healers.

Previous studies have concluded that dual practice activity among physicians might have positive as well as negative contribution for health care system. Besides contributing to the increasing health care access, dual practice has an issue mainly related with the decreasing quality in the public facility as physician put more attention in their private practice. Studies on dual practice mostly discuss theoretical analysis while the empirical evidence is still scarce especially evidence from developing countries. Our research fills the gap by providing theoretical analysis of dual practice and contributes to dual practice evidence using Indonesia as a case study.

Indonesia is one of the countries allowing dual practice physician since 1970's. One of the purposes is providing more services with limited physician so that people can access a formal health care which is a treatment provided by health care personnel and not self-treatment nor traditional healer. The health care utilization is increasing from 15% in 1996 to 34% in 2006 (Susenas survey 1996 and 2006). The percentages describe the proportion of population reporting illness who utilizes health care facilities in the preceding month of the survey. The number of physicians shows increasing trend. The average physician ratio is increasing from 16 physicians per 100,000 populations in 1996 to 37 physicians per 100,000 populations in 2013. Along with increasing physician ratio to ideal rate which is 45 physicians per 100,000 populations based on national target, the policy is concerned to some more adaptions when the objective of health care enhancement has already achieved. The large area of Indonesia and archipelago characteristic of the country indicate that the dual practice policy should be lead into different direction by considering geographical difference. For example, the average physician ratio of all 33 provinces in Indonesia in 2013 is 37.2 physicians per 100,000 populations. The national average ratio seems promising as it is close to ideal rate of 45 physicians per 100,000 populations but the interval of the ratio is between 8.9 physicians per 100,000 populations to 151.5 per 100,000 populations. It means that there is a province with low ratio while there is also province with high density of physicians. In term of treatment quality in public facility, many informal reports mention that dual practice physician is closely related with the declining quality in public provider and high rate physician absenteeism in their public work.

Objectives of the thesis

This thesis uses microeconomic analysis to investigate questions related to dual practice mechanism in a developing country setting. We describe the objectives of thesis in Figure 1.1. The research presented in Chapter 2, 3, and 4 has general topic on the dual practice physician role in a health system with different emphasis in each chapter which can be read as a separate article.

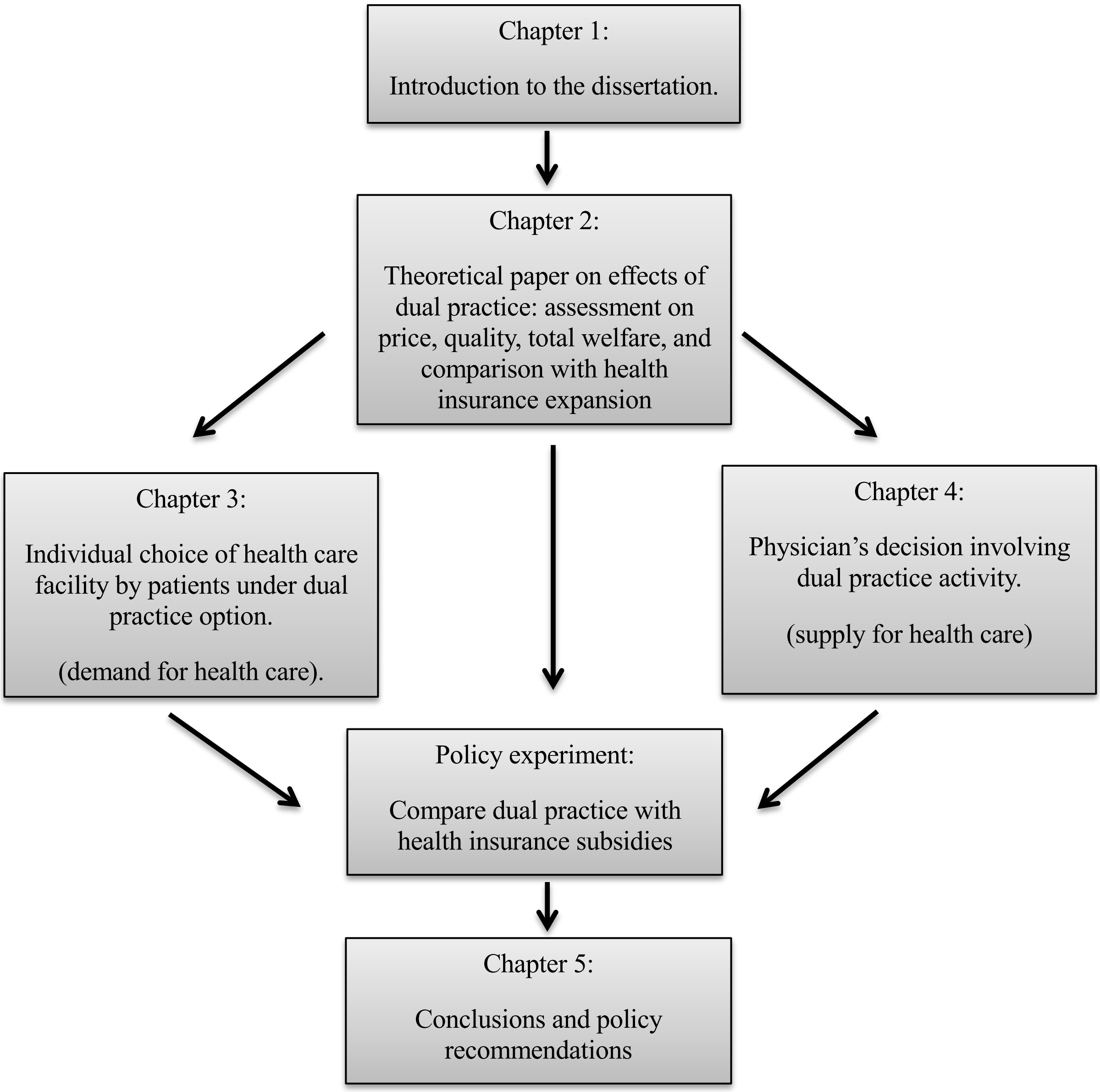


Figure 1.1 Summary of chapter descriptions in the dissertation

Chapter one is the introduction of the dissertation that covers the background of the research and the motivations behind the study of dual practice by physicians. This chapter also explains the importance of dual practice physicians in health care systems, particularly in developing countries.

We first focus on the impact of dual practice on patients (the demand side) and then the physician's decision regarding dual practice (the supply side). Chapter two is a theoretical work that investigates health care access by examining how public-private sector determines price under dual practice policy in the system. The chapter examines policy implications regarding access to health care through dual practice and insurance. We adjust the model by involving the insurance into the system to provide a policy implication related to health care access enhancement. Our theoretical framework considers dual practice as one of the tools to make health care more accessible. We will assess the dual practice policy by comparing with insurance coverage policy which also relates with health care access. The essential principle of the insurance in this research is that patients will only pay a certain percentage of treatment fees in public or private facility. The insurance situation also represents the developing country specification where the insurance coverage is still low. The analysis provides comparison of four situations where there is no dual practice-no insurance in the system, no dual practice-with insurance, dual practice-no insurance, and dual practice-with insurance. The assessment of each scheme is represented using total welfare to see which scenario provide optimal benefit for the health care system. The chapter also analyses the reaction on the private price when the population with insurance is increasing. Our theoretical work requires empirical measurement of demand side and supply side that will appear in the next two chapters. The two means of health care access enhancement: dual practice physicians and insurance will appear again in empirical study at Chapter 3 as part of policy explorations to see how dual practice affects the health care system. We complete the study with the analysis of quality treatment in public and private sector to see how dual practice will benefit quality of treatment.

In chapter three, we provide the empirical analysis on dual practice from the demand side using Indonesian data of Indonesian Family Life Survey 5 (IFLS 5). The chapter explains how patients decide in which facility they are willing to visit during the illness periods with the existence of dual practice in the system, whether dual practice could switch patients from non-formal treatment into public or private facility. In this case we differentiate the choice into: public facility, private facility, and other facility. The latter option includes the non-physician attendant facility such as midwives practice, nurse practice and traditional healer. We are also interested to see how monetary factors such as income, price and insurance as well as non-monetary factors such as travel cost and waiting time affect patient's choice. We provide two policy experiments by simulating the additional number of dual practice physician and the number of people with insurance coverage under the same budget to see which one is directly affecting individual decision to choose health care facility. The objective of doing the policy experiment is to measure the magnitude of each policy affecting the access to health care.

The fourth chapter of the thesis provides the empirical evidence on the supply side using Indonesian data that collected from Indonesian Family Life Survey 5 (IFLS 5), Indonesian Potential Village Survey (PODES0 2014, and Census Population (SP) 2010.

In this chapter we analyze the determinant factors for physician choosing to work in public sector only, work in private sector only or work in both sectors as dual practice physician. We analyze what factors make a physician to be involved in dual job activities. Our main argument based on previous literature is that additional income is the primary factor involved in the physician's decision. Our case study emphasizes the importance of geographical location in physician's working decision. The result supports the indication of development gap which is a usual characteristic of developing country. We complete our supply side analysis with the direct relationship between price of treatment, dual practice physician, and insurance coverage. Our study provides a simulation on public salary to estimate the minimum salary for physician if he works only in public sector and leaves the dual practice.

The two empirical analyses in this study use secondary data in novel way by combining household and community data. Our study has used the available data to provide analysis on dual practice physician although this activity is not regularly monitored by the health authority. Our analysis overcomes the challenge from the limited dual practice physician data especially in identification process. The detail of data sources is available in the next sub section below.

The final chapter contains the conclusions of the dual practice study from the theoretical discussion and empirical evidence of demand and supply side. This chapter summarizes our policy recommendations for dual practice physician continuation policy in Indonesia that comes from our findings. The chapter mentions possible general developments for the future research of dual practice study.

Finding relevant data

The major challenge in our research is to find a relevant data for the empirical work of dual practice demand and supply in Chapter 3 and Chapter 4. Our study is specifically dedicated to analyze the dual practice policy as a part of health care access enhancement in Indonesia. The main data needed in our research is a dual practice physician data. The available data on annual physician monitoring report from Ministry of Health has never mentioned formally about the dual practice activities. This practice actually can be identified from physician registration process in every regional health office in Indonesia. Physicians have to register in regional health office if they want to start practicing in public or private facility. However, data from this office is only for administration purpose and it is not fit for our research due to the complexity in collecting data from each regional health office.

We decide to use a secondary data from Indonesian Family Life Survey wave 5 (IFLS 5) that was held by RAND and Survey Meter Indonesia. Data from this survey allows us to identify dual practice physician activities and also provide data for the demand of health care in Chapter 3. The IFLS 5 survey was held in period at the end of 2014 until 2015. The survey is using households as the unit observations to collect information on socio economics, education, working labors and health. The survey also collects facility information available in the community, particularly on health and education such as schools, public community health care and private health care facility. For our research purposes, we use the household information and health care facility information.

The IFLS 5 was held in 23 provinces among 34 provinces in Indonesia. The IFLS 5 has a total 16,204 households and 50,148 individuals being interviewed. We use the particular individual sample of 5,695 that are visiting health care facilities for the outpatient in the last four weeks prior to survey. The outpatient care is used because its occurrence in the survey is more often compared to inpatient care, hence we can get a sufficiently large sample size. To avoid possible health care decision bias, we only include individuals aged 15 years or more and the visit that indicates the first visit. We assume that adult individuals have their own decision regarding health care. The first visit data avoids physician intervention on the individual decision. We get 2,686 selected individuals in this step. The sample is then being matched with dual practice physician identification and becomes 1,326 individuals. The other matching process is between individuals with the corresponding health care facility being visited. The IFLS data allows us to track which individuals visit which facility but not all facilities are being interviewed, hence the matching sample is 1,116 individuals. The main problem in the matching process is on the high rate of missing values especially from private facility. For example 47 percent of private facilities do not fill the quality questionnaire completely. In public facilities the missing value rate is quite low. The percentage comes from the fact that the main purpose of IFLS 5 is to get facility information so it is not mandatory to interview physicians as facility representative. The potential bias might come from the low response of quality information hence we take the strategy by using area identification to match the quality information of facility with the household area residency. As long as the information is available at the area level, the data can be match with household.

Data on physicians for Chapter 4 comes from two questionnaires of IFLS: public community health center questionnaire and private health care facility questionnaire. Both questionnaires have slightly different structures of physician descriptions. We identify dual practice physician from public community health center questionnaire as the physicians who work in public community health center and also work in private practice. From private facility questionnaire, dual practice physicians are physicians who work in private facility but has primary job as government workers in government health care facilitates. The detailed physician information will be captured during the survey if the interview process involves physician but unfortunately in some cases the interview process were attended by non-physician staff such as front desk officer, nurses, or midwives. Based on IFLS guidelines, the interview process for the health care facility questionnaire does not require physicians as respondents because the primary purposes of the survey is more related with health care facility information and the more appropriate person to answer the questionnaire is the administrative staffs or medical personnel with administrative knowledge. The total physician in our sample for the analysis in Chapter 4 is 920 physicians.

Our attempt to manage data from different sources of questionnaire to analyze dual practice in Indonesia is up to our knowledge, the first of its kind. The data preparation is one strong point in the study because the regular data available cannot possible be used directly in the analysis of dual practice physician in Indonesia. A careful process has been taken to meet the objectives of the research.

Summary

We present a brief summary of each chapter and an overview of the results.

Chapter 2: Dual Practice Physician in a Developing Country Health System

This chapter will analyze the relationship between public and private provider under dual practice regulation in term of price and quality setting in the public facility. This theoretical work is vital to link dual practice from demand and supply side that also appears in chapters three and four. The research wants to answer particular questions on how a private provider selects its price and quality level after knowing the public price and quality set by government under dual practice compared to non-dual practice regulation. The model also emphasizes the existence of insurance scheme in the system. Health care access enhancement in developing country usually takes one of two forms increasing the supply through allowing physicians to have dual jobs and increasing financial access through insurance coverage. We use both mechanisms in the analysis to capture patient's decision on accessing health facility and physician's decisions on working place under several situations: no dual practice-no insurance, no dual practice-with insurance, dual practice-no insurance, and dual practice-with insurance. The last issue is justifying in which situation provides the highest benefit by taking total welfare that comes from patient's utility, providers' revenue, insurance company and government transfer. We consider two kinds of welfare; the first is welfare in the long run where the price and quality has longer time to adapt to its equilibrium. The second is the welfare in the short run where we examine the immediate effect of having dual practice or insurance in the system, holding the price and qualities constant.

We develop a model based on Hotelling's work on spatial competition to analyze price and quality in private facility under dual practice regulation and insurance policy. The health care system consists of public and private health care provider is similar with what represented in the Hoteling model. Both facilities offer similar treatment and patient can only consume one treatment from a specific facility. This research follows Brekke (2006) and Kuchinke (2015) with some adjustments. It holds similar ideas on using the Hoteling model to construct the interaction between health care providers. Our model assumes that sick patients always look for treatment from public or private health care facility. The latter might refer to private traditional healer or non-physician practice for some patients. We use a similar model to explain price competition when one of the providers sets a standard price and quality. In our work, public price and quality in the public facility will be set by the government in the first stage. The private sector then will respond by setting its price and quality of treatment.

The dual practice has a role to lowering the private price driven by demand shift from patient's perspective and with dual practice there are more health care provided in the public system. So that patients can have more options on selecting facility. The insurance as predicted has different direction with the price, that insurance availability driven to higher price in private sector. The more massive insurance coverage to population also impact on the higher price in private sector. The comparison on total welfare shows that welfare under dual practice might be higher or lower than insurance regime. In the long run, insurance policy offers higher welfare than dual practice policy when demand of public and private facility are high, driven by the easier access from the insurance. Dual practice and insurance coverage might decrease or increase total welfare in the long run depends on parameter values. In the short run, dual practice policy might have higher welfare compare to insurance policy, when demand in public facility is higher enough to still cover the loss from the private sector caused by low demand in private facility.

Chapter 3: Dual Physician Practice and Health Care Demand in Developing Country Study Case in Indonesia Using IFLS Data

This chapter describes the patient's decision on selecting health care choices to reflect the demand aspect of our dual practice study. The primary motivation comes from the fact that the initial purpose of having dual practice in the system is for people to utilize more the formal treatment rather than non-formal treatment such as non-physician base treatment and traditional healer. Under dual practice existence, we expect that patient will be more likely to visit formal care provided by physicians in public and private health care facility. We investigate that dual practice existence influence individual decision's to visit facility. The dual practice here is a proxy measurement by the percentage of dual practice physician in the area where individuals live. We suggest that monetary factors such as income and price of treatment as well as non-monetary factors such as travel cost and waiting time have importantly affected the individual decision in the facility choice. We also include individual characteristics which is a social and demographic factor in the study. The additional important factor is that individuals are also concerned about the facility quality when visiting health care facility.

The study uses IFLS 5 household information and takes the individual as our unit of observation. The health care facility choices are simplified into three categories from the seven categories available in the questionnaire: private health care facility, public health care facility, and other. The first two are health care facilities that provide formal treatment by physicians. The last category captures the non-formal health care facility that attended by non-physician such as midwifes or nurse and traditional healer.

The first estimation addresses the question on how dual practice influences individuals on deciding which health care facility to visit. We run a multinomial regression model with a categorized dependent variable of individual visit to health care facility. It consists of three categories: public facility, private facility, and non-physician practice (midwife practice, nurse practice, and traditional healer). The main independent variables are percentage of dual practice physician in the area and insurance coverage. We also include geographical identification, price of treatment, travel cost, and waiting time. Our research has also considered other estimation methods that might fit the health care demand model such as a nested multinomial logit. A likelihood ratio test suggests that the nested multinomial logit in our case is not better than multinomial logit model as it is usually the case in the previous literature of health care demand model. The bias might rise from the insurance variable to individual choice of health care facility. We employ the two-stage residuals inclusion (2SRI) for the model after correction bias and compare with the initial model of usual Multinomial logit for the model before correction bias. The second estimation is using logit regression to see how quality aspects influence individual decisions, where individual will only select between public or private facility. A different estimation process has to be taken as the quality information is only available for the public and private health care facilities while there is none for the non-physician facility and traditional healers.

The result shows that dual practice is more important in switching patient from private facility into public facility rather than switching from non-physician facility and traditional healer to public facility. Furthermore, the increasing percentage of dual practice physician in the area drives individuals to less visit the private provider. On the other hand, insurance ownership shows a significant effect on driving people from traditional healer to public facility. Monetary factors as well as non-monetary factors significantly affect individual choice on health care facility. We compare the analysis of proposed policy to increase access to health care facilities through two policy instruments: insurance coverage and dual practice. The results show that extending insurance coverage gives higher impact on the health care demand compared to increasing the number of dual practice physician. The increasing number of health care insurance beneficiaries can shift people from visiting traditional healer into formal practice, in this case is the public health care facility that receives more patients. The increasing number of dual physician practitioner seems only to shift individuals from private facility to public facility. Insurance coverage might show higher effect to individual health care demand than dual practice policy because insurance only benefits the single user of insurance beneficiaries only. On the other hand, a dual practice policy might have larger effect in term of community level because the existence of dual practice physician will be utilized by groups of people.

Chapter 4: Why Physician Engage in Dual Practice? Evidence from a Developing Country

The research questions in this research are related with what motivations drive physicians on selecting a working sector. Physicians reflect the supply side of health care system that likely effects of a dual practice policy stated by the government. We include the indirect effect on equilibrium price of private sector from dual practice existence and health insurance coverage. The result will be crucial for determining dual practice policy in Indonesia.

The paper estimates factors influencing physicians on being dual practice physicians versus being private physicians or being public physicians. The additional income is an important motivation that drives physician to engage in dual practice. We emphasize that geographical characteristics such as urban rural and island identification might significantly affect physician because of the particular situation in Indonesia. Physician decision might also consider the health care need and competition, while we also believe that individual characteristics such as experience, male, education, and origin also have important role on physician decision. We provide the analysis with experiment on the public salary in order to evaluate the dual practice physician regulation in Indonesia. We estimate the probability of physician being dual practitioner using the main model of alternative specific conditional logit and the alternative of multinomial regression that regress physician working choices (private, public, or dual practice) on independent variables (gender, education, language, urban-rural, Java-Non Java island, income, years of experience, percentage of elder population, and physician ratio). The main model consists of two models that have different estimation process of physician's alternative income. The first one is using the linear regression and the second is using instrumental variable approach (endogenous switching regression) to consider endogeneity problem.

We use physician's data from IFLS 5 community facility questionnaire to estimate the model. The merging data from public community health center and private facility questionnaire is the first attempt ever done in the dual practice study under the limitation data of dual practice physician activity in Indonesia. After identification process on dual practice activity and imputation on some variables due to missing values, some of the results confirm a previous indication on the crucial variables influence physician's decision. Additional income still becomes the core variable that drives physicians on being dual practice. Physicians with higher income will less likely working as dual practitioner. We can differentiate the physicians' probability being dual practice based on the geographical characteristics, that physician in rural and Non-java Island has higher probability engaging on dual practice. The dual practice also has positive correlation with the health care need and competition among physician, when there is more potential need on health care and less physicians in the area, the probability being a dual practitioner is also rising. We find that male physicians and more senior physicians are less likely working as dual practice compare to being a private physicians. The policy experiment shows that government will need more than five times current public salary level if they decide to diminish dual practice in Indonesia so that physicians only work either in public or private sector only. The indirect effect of dual practice appears in our study as the existence of dual practice is a downward pressure on the price of treatment in private provider. Our policy recommendation will concern on keeping dual practice physician under some limitation such as only allowing dual practice in specific region as indicated in this research, rural and Non-java Island. Allowing dual practice is a reasonable policy, in the Indonesian case, to provide sustainable health care services to people.

Policy Recommendations

Chapter 5 provides the conclusions and policy recommendation from the dissertation. Our research uses two policies to improve health care access, dual practice physician and insurance coverage. The dual practice physician is a public physician who works in private practice or private clinics after his public working hour. The dual practice in the system is associated with additional supply of health care. The insurance on the other hand, provides access by lifting the financial barrier to health care. Our theoretical framework suggests non-dominance regime between dual practice and insurance. In general, the dual practice policy will have higher welfare effect because it lowering downs the price in private sector. The insurance policy will have lower welfare effect as the price of treatment in private facility is increasing along with the insurance coverage.

The empirical results however suggest that individual's choice of health care is more sensitive with the additional insurance compare to directly adding dual practice physician into the system. The insurance coverage level is able to switch health care demand from non-formal treatment (traditional healer, nurse and midwife practice) into formal treatment (public or private health care facility). The effect of insurance is at individual level because it benefits only the people who have insurance coverage. The dual practice effect might be larger at community level because more people can be served with the existence of more dual practice physicians in health care system.

The supply side analysis in our research supports the argument that additional income is important motivation for physician involving in dual activities. The dual practice is a mechanism to keep physicians working in public sector under low public salary. Our simulation shows that diminishing dual practice from health care system is too costly for the health authority in order to compete with private sector for physicians.

Chapter 2

Dual Practice Physician in a Developing Country Health System

Abstract

This research analyzes how public and private sector determine price of treatment and quality level under dual practice regime and insurance coverage policy. We examine policy implications as alternative policy interventions regarding access to health care through dual practice and insurance by standard welfare analysis in the long run and the short run. We find that the dual practice decreases the price in private operator. The direction of the price in private facility follows the public price set by health authority. Insurance coverage triggers the increasing price in private sector. The higher percentage population covered in full insurance leads the private facility to respond by increasing the price of treatment. The quality of private facility is following the increasing or decreasing price itself. The welfare of policy interventions comparison in the long run (after price adjustment) and in the short run (before price adjustment) provides similar results. We conclude that there is no dominance welfare effect between dual practice regime and insurance coverage but in general dual practice effect can be expected to have higher welfare compared to insurance effect in long run and short run.

Keywords: physician, dual practice, insurance, welfare

2.1 Introduction

This research will focus on how dual practice regulation will affect patient's decision on the facility choice and how private sector reaction in term of price and quality treatment being offered in the facility. Our study will analyze the effect of dual practice and insurance coverage in short run and long run. The study uses a developing country as a background particularly for the primary care or non-emergency care. Hence we construct the model by using some features that appear in most of developing countries. These features are dual practice physician and insurance coverage that represent health care access situation in developing countries and suit with our research purposes. The first one is dual practice policy where in most cases, dual practice physician practice is allowed with a loosely restricted regulation. The second characteristic is the limited insurance coverage among its population. This research also examines the policy implications regarding access to health care through dual practice and insurance coverage. The policies represent instrument to increase health care access as the initial purpose of launching dual practice policy. We calculate the total welfare in each regime in order to justify the effect of dual practice and insurance in the short run and long run. The theoretical framework in this paper is also an initial step before we explore the empirical analysis on demand and supply side related dual practice using developing country data as study case.

Physicians in providing health care services can work in two sectors; government-owned facilities or private health care facilities. In the mixed health care system, there are also physicians who work in both sectors, and this phenomenon is called dual physician practice. Previous literature mentioned it as "moonlighting" that refers to doctors who work in private clinics after office hours in the public health care facilities. Garcia-Prado and Gonzalez (2011) describe many forms of dual jobs in related activity for a physician in the field of education, training, sale, and practice where the latter is the most common seen and considered to have a significant effect in health care system. Russo et al. (2013) in research of dual physician determinants in three African cities find four distinction characteristics of dual physician practice related with public health care facility: private practice outside, beside, within and integrated into public practice. The dual practice appears not only in developing countries but also in more developed economies countries. In Austria, 100 percent physicians work as dual practice in public and private facilities while in Ireland more than 90 percent physicians are engaged in both sectors. In the United Kingdom, about 60 percent doctors who have contracted in National Health Care System also work in private facilities. The dual physician practice is widely recognized in African countries such as Egypt, Mozambique, and Zambia. The practice is also common in Asian countries such as Indonesia, Thailand, Vietnam, Cambodia and many more.

Dual physician practice is mostly regulated in more developed countries. Dual practice for physician is categorized as illegal practice in Canada. The government in Spain, Portugal, and Italy offer rewards for physicians who work solely in public. In Austria and Ireland, physicians are encouraged to perform private activities. The earning limitation is applied in countries such as UK and France where 10 percent of physician’s gross income is coming from private practice for UK and 30 percent of total physician’s income is the limit for private practice income in France. However, the practice is still unregulated in most developing countries although it is getting more attention from policy maker because its massive practice and potential effect on health care system. The unregulated dual practice physician usually takes place without particular limitations from the health authority compared to the regulated one. The lack of human resource and poor monitoring are usual reasons behind the unregulated practice. Having dual practice being regulated is claimed that it creates more conducive physician's workplace and leads to the better quality and patient's welfare from the provision of treatment.

The broad scale of dual physician practice is contrary to basic labor a supply theory (Lang, 1994) that predicts individuals would work more hours in their highest paying job rather than hold multiple jobs. It also contradicts the theory of incentive design (Holstrom & Milgrom, 1991) who shows that employers would want to constrain employee temptation to divert time and attention. In other words, the ordinary workers cannot work in two firms at the same time. There are motivations on why physicians want to work in dual practice. Income added is usually the primary motivation while the other motivations are: expanded or complementary use of professional skills, clinical autonomy, broader professional contact, reputation building, and flexibility of private practice (Garcia-Prado & Gonzales, 2011). Humphrey and Russel (2004) identify the motivation behind the dual practice is to access alternative facilities. They also mention that physicians engaged in dual practice to relief from high pressure and low appreciation in public environments.

Economists agree that dual practice has positive and adverse impacts on health care provision in the country. Shorter waiting times to get treatment and better access to health care are some of the positive implications of the dual practice. A public sector usually provides free treatment that has made a long queue for individuals to get treatments in public. Dual practice makes other options for people who want to get faster treatment with additional cost by providing care in private sector. The more people get treatments in private, the sorter a waiting time in the public sector might be. In most developing country where public facilities still scarce, physicians work in private clinics despite their primary duty in public facilities to expand health care treatments in remote areas. Dual practice contributes an adverse effect on health care provision. The areas that are initially served by public health care facility during working hours now can have alternative option from the public physicians who decide to open private practices. Profit from private sector becomes main attractiveness for physicians to involve in dual practice. The activities in private sector indicate affecting their performance in public such as skimp on public working hours, financial interest by diverting patient to private service, compromising the efficiency and quality of public health service and tend to neglect the poor (Hipgrave & Hort, 2013). Despite the fact that dual practice is a standard feature in health care system, there is still no consensus on its net effect. The argument is reflected by different regulations on dual practice among countries, although the discrepancies also more related to the heterogeneity of health care system and environment. Regulation of dual practice is needed to optimize the health care system where public and private work side by side. Lessons learned from developed countries where they have already regulated the practice showed that dual practice regulation could function with support from other components such as public funding, physicians supply, and technology. In the developing countries where the priority is in the health care provision, dual practice arrangement is considered less important so that it is still unregulated in most cases. Beside that empirical study related dual practice is still lack. Therefore research related dual physician practice is still needed in theoretical and empirical studies.

In health care system where government is funding the public provider, a constraint in government budget makes limited treatments offered in public health care facilities. The government is also interested in controlling public health care demand, for example by providing limited number of physicians and practice hours in public facility. The government determines the price of treatment in public sector and obliges to provide health care treatment with certain level of quality. One of the emerging issues in the health care system is the health care access, whether people can get treatment without difficulties from financial and non-financial factors. The government might eliminate the financial barrier by offering a standard treatment in public provider that usually has a lower price than its competitor in private sector. The non-financial factor related to access to health care is a cost that paid by the patient outside the treatment cost, such as travel cost. In the remote areas where still lacking transportation means, the travel cost is a tremendous obstacle to access health care.

Dual practice policy in developing countries is closely related to health care enhancement. The practice is expected to overcome difficulties on access and mainly to provide more health care treatment in the system. A physician who involved in dual practice will work in private sector by opening a private practice or working in private clinics after public working hours. Patients have more options to decide which provider they want to visit in getting health care treatments. The dual practice mechanism seems an ideal tool to guaranty access to health care. However, is it so? Different point of view on the dual practice regulation shows that the practice indeed increases the supply of treatment in the system, but do all individual afford to get it? We mention before that dual practice physician will open a private practice and it usually offers treatment in higher price compare to a public provider. From a non-financial perspective, such as travel cost, does dual practice can reduce the financial cost borne by the patient to access health care?

One tool to minimize the financial barrier of getting health care treatment is by providing insurance or government subsidized insurance for the poor income group. The usual insurance scheme commonly refers to a sharing risk mechanism between insurer and insurance provider where insurer pays premium and will get health care benefit such as full or partial reimbursement of fee treatment. Government might intervene the insurance scheme by taking over the premium payment for a specific population. This mechanism can be found in health care system where government has obligation to provide health care for the residents, but the sources are limited. Instead of providing free care, the government can combine between providing low price treatment in public facility and giving access to insurance for the people who are unable to afford the treatment fee. The insurance scheme will levy the burden of treatment fee, although there is a possible situation when individual also suffered from non-treatment cost such as travel cost. Low income patients might suffer from paying travel cost to health care facility that prevents them in getting health care treatment. The further research that combines the dual practice benefit and financial as well as non-financial aspects is needed to fully explain how health care access has been developed in the health system.

Access to health care has been a focus of the research related with health care policy and health services. The term access itself has been translated into different definitions. Penchansky (1981) in his research defines an access as degree of fit between user and provider and specified access into five dimensions: availability, accessibility, accommodation, affordability, acceptability. The decomposition of access is claimed to be useful from political point of view that it concentrates into specific policy actions on overcoming obstacles of health care service. In the research related with equity, Waters (2000) defines an access as the use of health care by individuals with a need for care and he measured the need using a self-reported morbidity. The similar definition appeared in the researches by Gilson (1988), Mooney (1987), Menzel (1993) and Mapelli (1993). A different definition of access can be found in (Culyer & Wagstaf, 1993) as they describe access as a cost for receiving care, the highest feasible consumption, or as foregone utility. Goddard & Smith (1998) emphasize the access as a supply consideration so that similar services are available to patients with similar need. The more recent research mentioned access as the composite from the previous research. Evans, Hsu, and Boerma (2013) emphasize access as the primary key when mentioned it in discussion about universal coverage and universal access. According to their paper, access has three dimensions. The first is a physical ability that can be referred to supply of reachable health care services such as the health care facility, opening hours, and other organizational aspect that allows people in need to get the services. The second is financial affordability which is a people's capability to pay the treatment without difficulties. It is also including the indirect and opportunity cost to get the treatment such as transportation cost and time lost from visiting health care facility instead of working. The third is the acceptability that is related on how people willingness to seek care in the case of sickness happened.

Research on dual practice has been developing in recent years. Among the previous researches of dual practice, none of them directly links the dual practice with health care access, theoretically or empirically. Some of the previous researches that motivate this research are summarized in Appendix, Table 2A.1. Barros and Martinez-Giralt (2002) compare the effects of three reimbursement rules (no insurance, insurance with a preferred provider, fixed reimbursement rate) on the prices and qualities chosen by competing healthcare providers, and hence on social welfare. Two alternative assumptions on the timing of decisions are considered whether it is a simultaneous decision between qualities and prices for primary care sector or sequential decision with quality is taken as first decision then is followed by price for specialized health care sector. Brekke, Nuscheler, and Straume (2006), where the objective is to characterize the socially optimal exogenous (regulated) price common to two competing providers, when they choose only the quality of their respective products, or both the quality and their location. This is done with two alternative assumptions on the ability of the regulator to commit to its chosen price. Kuchinke, Zerth, & Wiese (2009) study the competition in the case of standardization in regional health care markets where there is no price competition. They consider about the timing when health care providers will compete on vertical (quality) after the scope of medical treatment is determined.

The oft-heard argument in the researches about dual practice is whether the dual practice has an impact on public service quality. Bir and Eggleston (2003) suggest that dual practice may increase or decrease public service quality depends on whether the benefit of dual practice attracts highly skilled physicians and another social cost. Physicians as a central role in health care system contribute to the quality of the treatment and have a particular interest in their profit. Gonzales (2004) shows that public sector quality improves as physicians who work in public sector are improving their effort to gain reputation to get more private practice revenue. Physicians have incentives to over-provide public treatments. Health authority can use policy of limiting physician's earning from private practice to reduce over-provide treatment in public practice. The other policy mentioned in the paper is an exclusive contract that applies optimally in the low salary situation. Besides quality treatment, dual practice closely relates to physician's incentives and patient selection to get benefit from physician's private practice. Biglaiser and Ma (2007) study the incentives of dual practice which public physicians can refer their patients to their private facilities with concerning to the quality of care provided and welfare. Their model differentiates physicians in their degree of motivation. Their study suggested that dual practice limitation by price ceiling reduces the adverse effect on the public sector and increase quality. Delfgaauw (2007) studies the provision of public and private health care with altruistic physician found that allowing dual practice can benefit all patients but allowing physician to transfer a patient from public to private practice reduces the patient's benefit especially patients that categorized as poor.

Research by Brekke and Sorgard (2007) analyze dual practice from the perspective of physician's labor supply and health care provision in public and private sector. They study the role of competition among physician that affect the health care treatment in both sectors. They find that allowing dual practice physicians "crowds out" public provision and results in lower overall health care provision. The health authority can offer a higher wage for physicians to decrease the adverse effect. The result also suggests policy implication of banning or allowing dual practice in health care system. Banning dual practice can be optimal in the case where physician's competition is weak or treatment between public and private is strictly substituted. In the case when physician's competition is strong, the mixed health care system with dual physician practice is preferred. Kuhn and Nuscheler (2013) use a different approach and setting to analyze the effect of the waiting list in the excessive supply of private care. They assume that free but regular treatment is provided to the public while intensive treatment with payment is available in private sector. The result shows that the physicians shift waiting time for the cost of public patients to increase the willingness to pay for private treatment. Waiting time turns to be socially optimal, over the provision of private care happens if and only if the waiting cost is sufficiently high. In the second best allocation, health authority chooses physician reimbursement in the public segment without any control over private provision. Their research suggests policy for dual practice regulation, banning dual practice may improve in the second best allocation, but it depends on the welfare weight the health authority attaches to physician profit.

The importance effect of dual practice in health care system leads health authority to regulate the dual practice. A recent paper that provides theoretical frameworks on dual practice regulation is Gonzales and Stadler (2013). They compare three dual practice regulations in the presence of physician's ability: banning the dual practice, rewarding physicians who work exclusively in public, and limiting dual practice in term of involvement and earning. They show that banning dual practice is never optimal since the benefit from the lower salary needed to retain doctors working in public hospitals is always smaller than the cost which arises from the distortion associated with the dual practice. Offering exclusive contracts is optimal only when there are limits in enforcing policies that restrict the dual practice. Limiting involvement in private is optimal then limiting earning because involvement limitation acts directly on the intensity of dual practice.

The dual practice situation can be captured using the Hoteling model. The original model is in Hotelling (1927), it is known as Hotelling's linear city model where he explains the spatial competition between two firms that selling similar product. The work of Hotelling has already expanded in many forms to accommodate economics extensions. A research of D'Aspremont, Gabszewicz, & Thisse (1979) shows that the solution in Hotelling's, where firms located in the middle of the line is incorrect. After choosing location and price, both firms will move a part to reduce the price competition. The adjustment of the model also involves the price competition. The intensity of price competition is decreasing with the product differentiation as showed in Picone, Ridley, & Zandbergen (2009).

We will explain some of the latter Hotelling framework that is relevant with health care especially closely related to our work. Brekke, Nuscheler, & Straume (2006) analyze the general case of competition where the product price is exogenous. They compared the two results where regulator can set the price before the location selection (full commitment) and when the regulator is not committing to set the price after choosing the location (partial commitment). The result showed that under full commitment, there is overinvestment on quality because of the optimal (second-best) price. The horizontal differentiation is insufficient if the transportation cost is high. The optimal price is the first best under partial commitment, but again the horizontal differentiation is high. Kuchinke, Zerth, & Wiese (2009) use Hoteling model to explain the competition in health care markets mainly in the standardized regional health care market with no price competition. The competition is in deciding the level of quality treatment or vertical quality after the scope of medical treatment is set (horizontal quality). They constructed the next step of comparison by letting one of the providers to set the level of vertical quality first then see how the other companion reacts to it. The result suggested that there is more variation in the supply but the standard follower has to leave the regional health care market.

This research emphasizes the importance of health care access policy that has main purpose to ensure people can get treatment in time needed. From health care access framework, our research adopt the definition of access by Evans, Hsu, & Boerma (2013) using the first two dimensions of physical ability and financial affordability and excluding the acceptability dimension. Dual practice physician is the physical ability that allows health care system to have more services available for the people. Dual practice might offer more services in term of making the distance of services closer to people and offering services in different opening hours. For example, dual practice physicians might open their private practice in different opening time with the public facility. The second dimension of access in our research is the insurance coverage. We use insurance as the mechanism that enables people accessing treatment in health care facility by relieving financial burden.

We use Hoteling model to represent the dual practice situation but we do not explore the location determination as happened in the Hoteling original work. Our research defines providers in the market consists of public facility and private facility. Also, the private facility later will be differentiated into the private facility with a private physician and private facility with dual practice physician that we will call them private facility and dual practice facility for short. In our framework, all patients will get treatment and they only consume one treatment from a specific facility. The treatment of primary and non-emergency care provided in both facilities is similar. This research is following the papers of Brekke, Nuscheler, and Straume (2006) and Kuchinke, Zerth, and Wiese (2009) in some different ways. It holds same ideas on using the Hoteling model to construct the relationship between health care providers. Kuchinke, Zerth, and Wiese (2009) emphasize the competition between private providers by setting the provider to determine the scope of medical treatment then decide on the quality of treatment. Our model points out the dual practice mechanism in the health care system using Hoteling model in its original form. We use the similar model to explain the price and competition when one of the providers sets a standard price and quality. In their framework, one private provider acts to be a standard leader in quality of treatment. In ours, providers are public and private providers, while price in public sector and quality of treatment in public facility will be set by the government in the first stage. The private sector will respond by setting its price and quality of treatment in the next stages.

The findings and their implications of this study will redound to the benefit of decision makers and providers (public and private) considering that dual practice is a common practice in developing country health system where health care provision is provided by public sector alongside the private one. Our study analyzes the public facility and private facility interaction in term of price and quality in providing treatment under dual practice regime and insurance coverage. Both regimes represent developing country situations where dual practice is allowed without strict regulation and low coverage of health insurance is present. The private sector reaction after health authority sets the price and quality on public sector will determine how health authority might manage to increase or decrease the price and quality level. We evaluate the advantage and disadvantage of having dual practice and insurance in health care system in terms of welfare. The long run welfare is the evaluation when we assumed that price and quality need time to adapt after regimes are authorized and the short run welfare is the immediate effect right after the policy on dual practice and insurance is launched. Access to health care is the motivation of this study and it works as a complement to the previous study on dual practice theoretical framework and contributes to dual practice research as it has many different settings to consider. The result will contribute suggestions for policy makers to gain optimal performance of dual practice and bring benefits to all.

In the sub chapter 2.2, we describe the time line of decision and patient's demand as the basic of our theoretical framework. The sub chapter 2.3 and 2.4 explain the price determination and quality determination under dual practice and insurance scheme. The sub chapter 2.5 and 2.6 are the calculation of welfare effect in long run and short run; the interpretations are included in both sub chapters. Continuing on sub chapter 2.7 is a policy implication and sub chapter 2.8 is the discussion. The final sub chapter of 2.9 presents conclusion.

2.2 The model

We provide here the summary of model specification of this study while further explanation is available in sub chapter 2.2.1 and 2.2.2. In our model, we have two facilities, facility 1 and facility 2 that are located in the extreme point of zero and one. The cost parameters such as cost to produce a treatment (c) and cost of quality treatment (φ)

are specific to these facilities, $c_i, \varphi_i, i = 1,2$. Health care providers can be active in two separate market segmented based on working hours as we described as "morning" and "afternoon":

- In the morning in all circumstances there is public provider in facility 1 and private provider in facility 2.
- In the afternoon, there are two circumstances related to whether dual practice is authorized or not in facility 1, there is:
  - either a monopoly with private provision in facility 2 (because dual practice is not authorized so facility 1 does not supply),
  - or a duopoly with private provision both in facility 1 and in facility 2 (because dual practice is authorized in facility 1).

One more consideration is the existing insurance in the system, therefore four regimes are considered as: No dual practice-No insurance (NN), No dual practice-With insurance (NI), Dual practice-No insurance (DN), Dual practice-with Insurance (DI). However by construction the NN regime is a particular case of NI and DN of DI with insurance variable (s) equals to one. The analysis will compare the two structurally different versions of model, depending whether outcomes of private provision of health care in the afternoon is assumed to be monopolistic or duopolistic, both with$0 \leq s \leq 1$.

2.2.1 Time line of decisions

The theoretical framework can be summarized as several steps of decision from different agents in the system. The time line of decisions in Figure 2.1 starts with the government institution that has authority in deciding health regulation and policy. We will call it health authority or government for short. It will regulate policy for access to health care. Health authority has a right to allow dual practice physician or to ban the practice in health care system. As happens in most countries, government mostly funds the public sector including public health care facility. Besides that, health authority is also responsible for providing a health insurance subsidy which allows people getting treatment with a reduced treatment fee in public or private facility. Health authority decides on general policy of the price in public facility (or treatment fee from patient's perspective) and the quality of treatment in the public sector. In our timeline, we assume that policy on access using dual practice regulation and insurance subsidy are easier to manage by government so that the price and quality level in public sector will not differentiated based on the set of government regulations.

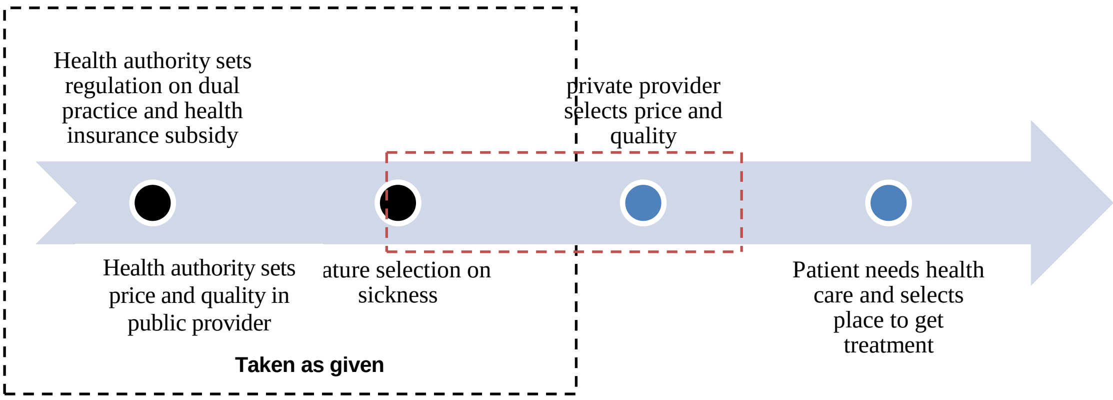


Figure 2. 1 Timeline of decisions

There are three providers of health care in the model. The first one is a public health care facility; a government owned facility and consists of public physicians. The second facility is a private health care facility where private physician provides services. The facility is managed by private physician or private company. The last one is a dual practice facility, a private health care facility where dual practice physician serves patients. The dual practice physician is a physician working in public facility in the morning and providing services in private health care facility in the afternoon. The phrase dual practice in general can be expanded into dual job combination between non-practice job and practice job but our case is specifically related with a dual job that requires physician to have practice or providing health care service in different sector, public and private. One should be noted that morning working time and afternoon working time are not intersecting each other.

There will be two settings where health authority will regulate the dual practice. In the first setting, health authority does not allow dual practice where physicians can only work in public or private sector only. In this setting, the providers consist of public facility and private facility. In the morning, providers are public and private, and in the afternoon, patients are getting treatment from private facility only. We assume that both facilities provide primary and non-emergency care. For the second setting, the health authority allows dual practice where a physician can choose to work in public, private, or both. In the morning, providers are public and private facility; while in the afternoon, provider consists of a private facility with private physician and a private facility with dual practice physician. We use the term of private facility for referring the first provider while the latter is called dual practice facility for simplicity.

Our framework will compare between a situation without insurance and a situation with insurance available in the system. The insurance refers to health insurance that is provided by government. The insurance mechanism in our study is simplified into direct subsidy so that health authority provides insurance for people without paying any premium. This is a similar situation in most of developing countries where the rate of insurance participation is still low especially for the low income group. The government usually subsidizes the poor ones, while in our case the government provides insurance subsidy for everyone when we frame the situation with insurance in health care system. The insurance subsidy relieves a part of treatment fee when people decide to visit public or private health care facilities. It is important to mention that in our frame work, people can use insurance to get treatment in both public and private facilities. Health authority then decides the level of health insurance subsidy as percentage of treatment fee that will be paid by the government while the rest will be paid by patients. By this description, there is no issue of patient's moral hazard from using insurance to get treatment. We assume that health authority is capable in providing a certain amount of subsidy. We do not involve further aspect of mechanism to fund the public sector such as taxation.

The next two stages are natural selection on sickness and private provider selects price and quality. These two steps can be executed not in sequential order and we put different lines (red dash) to describe the unordered process in Figure 2.1. Their positions in the time line can be exchanged one another with no effect in the analysis. When natural caused occurred, an individual might suffer from illness and he will need a treatment. We categorize sickness as a random event. On the other side, the private provider will select price and quality of treatment without observing the nature move. Private provider cannot observe physician's information of illness condition during selection of price and quality level. The provider cannot identify which individual gets sickness or the level of severity but it only sees sick people who showing up for treatment. The model assumes that patients always consume one treatment of health care in the chosen time and chosen facility.

The final stage is when people decide in which provider they will take a health care treatment. We differentiate the health care need in two periods of time, morning working hours and afternoon working hours. This division can be interpreted into different perspective, for example people might visit health facilities during public working hours (regular working hours) and the extended working hours (after regular working hours). We will use morning and afternoon term for simplicity. People can choose between public and private provider in the morning; this is a usual time when public facility offers services during office hours. In the afternoon people can choose from private provider only when dual practice is not allowed in the system. When dual practice is allowed in the system, patient can choose between private facility and dual practice facility. One should note that patient's decision to choose health care facility will be taken after people have illness and decide to seek care. The model neglects the possibility for people doing self-treatment or taking no care during illness period. Our research frame works more appropriately in the case of non-emergency care and specifically the primary care where the decision of health care choice more depends on the patient side rather than influence of medical advice from physician.

The model also takes physician decision to involve in dual practice as a taken as given decision and not included in our theoretical framework. Our initial attempt has explored the possibility to include the physician's decision into the model but it only adds complexity without implying the precision on overcoming research question. While we have to focus on our study to analyze the trade-offs between two alternatives policies, dual practice policy and insurance coverage. We specifically analyze the physician's decision later in our empirical study at Chapter 4.

This research only focuses on the last two stages while the first three stages are treated as taken as given. Our research is a sub game from a larger multi stage game as some parts of the game are being set, and the solution is solved using backward induction. We provide summary of actions for each agent of our analysis in Table 2.1.

Table 2. 1 Agent's decision in the last two stages of timeline decision

Private provider	Patient
Determine: • Price • Quality of treatment	Select health care facility between: • Public facility • Private facility • Dual practice facility

2.2.2 Demand for treatment

The general idea of allowing physician having dual job in public and private sector is to allow people to have more access to health care. The public facility usually has limited capacity to provide services for all people. Gonzales (2005) initiates her work by assuming capacity constrained in public facility. The dual practice enables public physician to open additional practice apart from the usual opening office hours. We model this description using differentiation of demand into two categories; demand at regular schedule and demand at after hour schedule. Usually regular schedule of the facility follows the usual working hours during the day while the after hour schedule refers to after public working hours or afternoon opening hours. For the consistency with previous explanation, we will call the demand at regular schedule as demand in the morning, and demand at after hour schedule as demand in the afternoon.

When dual practice is allowed in the system, a patient selects health care facility based on visiting time to get treatment in the morning or in the afternoon. In the morning he can choose between the public provider or private facility. In the afternoon, he can choose a private facility with a dual practitioner (dual practice facility) or private facility with a private physician (private facility). This is a capacity increase in dual practice facility while it is decreasing capacity for public facility. Without dual practice in health care system where physician only works in public or private facility, the patient chooses between public and private facility in the morning visit, while in the afternoon, all patients go to private practice only. To simplify the presentation of main effects, patients do not choose the period in which they demand care. The model assumes that all patients consume only one treatment in selected facility and selected time period.

The detailed of patient decision on selecting health care facility is described in Figure 2.2. The patients choose health care facility based on the existence of dual practice regulation and working hours. The decision in the morning will be the same between two regimes that people may choose between public facility and private facility. The difference appears for the afternoon's option, under dual practice regime, patient can choose between dual practice facility and private facility, while under no dual practice regime, all patients go to private facility.

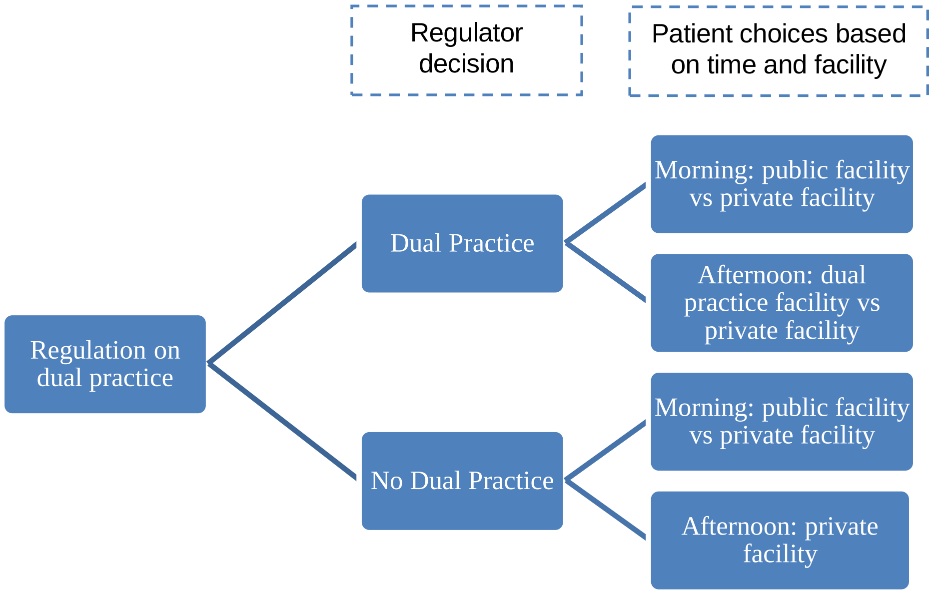


Figure 2. 2 Detailed decisions based on the regulation and working hours

In this research, patient's utility consists of individual income to represent goods other than health care treatment that can be afforded using the income, y. By putting income in the model, we define the price or treatment fee from health care provider $(p_i), i = 1,2,$ that should be paid by patient and it cannot exceed the income. The specific purpose of getting treatment in health care provider is for patient's benefit from health care treatment and it is measured in term of quality of treatment from different providers $(q_i), i = 1,2.$ Cost component from patient's perspective is travel cost, t, that depends on the patient's distance from the facility, x . We assume that the total distance is normalized to be equal to one. All patients are looking for care treatment and they are uniformly distributed in the line between providers, with maximum one. Patient will select between two health care providers that are located at the endpoint of segment length of one. The public facility is located at zero and private facility is located at one.

All patients eventually will get care and will be treated in one of health care facility: public facility, private facility, or dual practice facility. We realize that this is a strong assumption because under some circumstances not all patients can be treated in health care facilities. In the initial version of the model, we made some patients not being able to receive treatment due to financial constraint. That model had the same basic insight as the current one which has the merit of being simpler.

Patient's utility from public facility (U^{pub}) is:

$$U^{pub} = y + \widetilde{q_1} - \widetilde{p_1} - tx \qquad \textbf{(2. 1)}$$

Patient's utility from private facility (U^{pv}) is:

$$U^{pv} = y + q_2 - p_2 - t(1 - x) \qquad \textbf{(2. 2)}$$

The $\widetilde{q_1}$ and $\widetilde{p_1}$ are quality and price in public facility that will be set at fixed value by government at the beginning of the game. Public sector facility is assumed to have enough capacity to seize all demand at equilibrium prices, The setting of $\widetilde{q_1}$ and $\widetilde{p_1}$ are not drained the public capacity since changes in $p_2$will also change the demand for the public sector in the morning. The q_2 and p_2 are quality and price in the private provider that will be solved for the purpose of this research.

We compose demand for treatment based on time periods; the first one is the demand for treatment in the morning, and the latter is demand in the afternoon. The working time division captures the situation when public provider usually serves during the morning working hours, especially for providing primary care and non-emergency treatment. The feature of the model is implying that private facility has longer working hours than public facility. Private facility provides services in both times, in the morning and in the afternoon. The public facility is closed in the afternoon and the only provided facility for the patients is a private one.

Now we will define the demand function of health care provider where a patient seeks the treatment for each time period. We assume that patient only consumes one treatment during sickness episode from a particular provider (public, private facility or dual practice facility). It is also assumed that patients do not move between morning or afternoon working hours. The patient chooses between public or private provider in the morning working hours. We will write the demand notation as ${x_i}^{am}$ for morning demand of i-facility. Our framework define that in morning and afternoon working time, there are two facilities: public and private (morning) and private and dual practice (afternoon if dual practice exist) or only private facility (if dual practice does not exist). The demand in the other facility in the morning is denoted as ${x_j}^{am} = (1 - {x_i}^{am})$. The afternoon demand in the-i facility is ${x_i}^{pm}$. The other facility demand in the afternoon is represented by ${x_j}^{pm} = (1 - {x_i}^{pm})$. The $i, j = 1,2, with\, i \neq j$. The demand of public facility can be written as:

$$ {x_1}^{am} = \frac{t + \widetilde{q_1} - \widetilde{p_1} - q_2 + p_2}{2t} \qquad \textbf{(2. 3)} $$

The demand of private facility in the morning is:

$$x_2^{am} = (1 - x_1^{am}) = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2 - p_2}{2t} \quad \textbf{(2. 4)}$$

Patient visits private provider in the afternoon as the public provider has already closed after the morning working hours. The demand function when dual practice exists in the health care system means that patient can choose between private provider with dual practice physician and private provider with private physician. The private provider with dual practice physician, we called it dual practice facility for short, is a private practice where the physician is a public physician, or working in the public facility during the morning working hours and open a private practice in the afternoon. It is assumed that the dual practice physician provides services in the same location with the public facility. In the usual case; for example; public physician usually has housing facility in the same location with the public provider. He serves in public community health center in the morning working hour then in the afternoon he opens private practice in the same location. The dual practice physician might have benefit because patients have already recognized the facility location as the same place as public facility (in the morning). On the other hand, this physician might have higher workload because he worked in the morning and after hour services so he cannot provide optimal services to patients. Regarding this, patient in the afternoon might consider coming to private facility and expected to get better services. The demand function of dual practice facility can be written as:

$$x_1^{pm} = \frac{t + q_1 - p_1 - q_2 + p_2}{2t} \quad \textbf{(2. 5)}$$

The (p_1, q_1) is the choice of price and quality in dual practice facility. The demand of private facility in the afternoon is:

$$x_2{}^{pm} = (1 - x_2{}^{pm}) = \frac{t - q_1 + p_1 + q_2 - p_2}{2t} \qquad \textbf{(2. 6)}$$

In the case when dual practice is not allowed in the system, all patients will visit private provider with a private physician (private facility) in the afternoon.

In the next explanation, we will show when insurance takes part in the model. The insurance, in this case, is a percentage of treatment fees that should be paid by the patient, while the insurance company will pay the rest. Since the insurance is paid ex-ante, the insurance only influences income, y, but not the decision to look for a health care provider, public or private. We assume that insurance will cover whatever provider the patient decides to visit, whether it is public or private. Patient's utility from public facility with insurance is:

$$U^{pub} = y + \widetilde{q_1} - s\widetilde{p_1} - tx \qquad \textbf{(2. 7)}$$

Patient's utility from private facility with insurance is:

$$U^{pv} = y + q_2 - sp_2 - t(1 - x) \qquad \textbf{(2. 8)}$$

We can define the demand of public facility in the morning as:

$$x_1{}^{am} = \frac{t + \widetilde{q_1} - s\widetilde{p_1} - q_2 + sp_2}{2t} \quad \textbf{(2. 9)}$$

While the demand of private facility in the morning as:

$$x_2{}^{am} = (1 - x_1{}^{am}) = \frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2 - sp_2}{2t} \quad \textbf{(2. 10)}$$

By including the insurance component into the utility function, we arrange the demand of treatment in the afternoon under dual practice regime. The demand of dual practice facility in the afternoon is:

$$x_1{}^{pm} = \frac{t + q_1 - sp_1 - q_2 + sp_2}{2t} \quad \textbf{(2. 11)}$$

Demand of private facility in the afternoon is

$$x_2{}^{pm} = (1 - x_1{}^{pm}) = \frac{t - q_1 + sp_1 + q_2 - sp_2}{2t} \quad \textbf{(2. 12)}$$

The next step is to solve the price and quality in private facility in different combinations of dual practice and insurance coverage. We will explain and compare between the four cases that are given at the beginning of the game: when there is no dual practice and no insurance in the system, no dual practice but insurance in the system, dual practice but no insurance in the system, and the last one is when dual practice and insurance both appear in the system.

2.3 Price in the private provider

In this sub chapter, we will show the decision of private provider in setting the price in the responses of regulation on dual practice and insurance existence in the system. There will be four cases in the analysis: the case of no dual practice-no insurance (NN), the case of no dual practice but insurance is existed (NI), the case of dual practice but no insurance (DN), and the last case will be the case with dual practice and with the insurance in the system (DI). The private provider in facility 2 chooses the same price and quality in the two market segments (morning and afternoon). The equal price of private facility in the morning and the afternoon is in line with observed reality that private doctors/facilities required to announce/post their prices either by regulation or by management decision (reputation). It also related with ethical reasons. The difference price usually applied if it relates with different services such as emergency services which is beyond our scope of study. The equality of private facility is related to fixed elements of the facility. The sum of profit earned in the two segments is maximized. This does not hold for the competitor which is the dual practice facility, because in the afternoon (with dual practice), the price and quality in facility are obtained by maximizing the afternoon profit only. The morning price and quality for public sector is regulated by government and taken as given. The equilibrium price (${p_1}^{DN}$) and quality (${q_1}^{DN}$) or ${p_1}^{DI}$ and ${q_1}^{DI}$ depend on $\widetilde{p_1}$ and $\widetilde{q_1}$ indirectly through the equilibrium choice of private provider in facility 2.

2.3.1 Price in the private provider when dual practice is not allowed and no insurance scheme

We define the profit function for the private provider, $\pi,$ as a function of demand, price, and cost. The demand of treatment in private provider consists of demand in the morning working hours and in the afternoon after working hours. The subscripts equal to 2 denotes the private provider. The cost component of c_2, measures the cost of providing a particular treatment for a single patient in private facility. The φ_2 is a quality cost, a cost to improve treatment quality for private provider. The quality level of treatment, q_2 , will depend on this cost. We put abbreviation of NN attach on profit, price and quality for the no dual practice-no insurance scheme.

The profit function of private provider consists of health care demand in the morning where public and private provider are available and demand of health care in the afternoon where there is private provider available. The demand then multiplied with the price of the treatment minus the cost of treatment and cost of quality treatment.

$$\pi_{pv}{}^{NN} = D_2^{am}(p_2{}^{NN}, \widetilde{p_1}, q_2{}^{NN}, \widetilde{q_1})(p_2{}^{NN} - c_2)$$

$$+ D_2^{pm}(p_2{}^{NN}, q_2)(p_2{}^{NN} - c_2) - \varphi_2 \frac{q_2{}^{NN^2}}{2}$$

$$\pi_{pv}{}^{NN} = x_2{}^{am}(p_2{}^{NN} - c_2) + x_2{}^{pm}.(p_2{}^{NN} - c_2) - \varphi_2 \frac{q_2{}^{NN^2}}{2}$$

$$\pi_{pv}{}^{NN} = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} - p_2{}^{NN}}{2t}(p_2{}^{NN} - c_2) + 1.(p_2{}^{NN} - c_2)$$

$$- \varphi_2 \frac{q_2{}^{NN^2}}{2} \qquad \textbf{(2. 13)}$$

In order to get the price and quality equilibrium, we set $\frac{\partial \pi_{pv}{}^{NN}}{\partial p_2} = 0$, and $\frac{\partial \pi_{pv}{}^{NN}}{\partial q_2} = 0$. This is a first order condition for profit maximization of private provider. Hence from the profit function above we get,

$$p_2{}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} + c_2}{2} \qquad \textbf{(2. 14)}$$

$$q_2{}^{NN} = \frac{p_2{}^{NN} - c_2}{2\varphi_2 t} \qquad \textbf{(2. 15)}$$

By replacing the $q_2{}^{NN}$ in (2.15) to the $p_2{}^{NN}$ (2.14) and then moving the $p_2{}^{NN}$ into the left side of equal sign, the solution of price is:

$$p_2{}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} + (1 - \frac{1}{2\varphi_2 t})c_2}{2\left(1 - \frac{1}{4\varphi_2 t}\right)} \qquad \textbf{(2. 16)}$$

The complete steps to get 2.16 is available in the Appendix 2A.1. The following proposition results from the analysis.

Proposition 1: *The price of treatment in private facility is positively related with the price in public sector set by health authority. The higher the price in public facility is, the higher the price in private sector.*

Based on the solution of price equilibrium under no dual practice-no insurance regime in (2.16), the price of public facility, $\widetilde{p_1}$, is a positive nominator and has direct positive impact on the price of private facility. To confirm the Proposition 1, we conduct the comparative statics that shows the effect of increasing and decreasing price in public provider, $\widetilde{p_1}$. First we check the second order condition and find that:

$$\frac{\partial \pi_{pv}{}^{NN^2}}{\partial^2 p_2{}^{NN}} = -\frac{1}{t}$$

$$\frac{\partial \pi_{pv}{}^{NN^2}}{\partial^2 q_2{}^{NN}} = -\varphi_2$$

$$\frac{\partial \pi_{pv}{}^{NN^2}}{\partial p_2{}^{NN} \partial q_2{}^{NN}} = \frac{1}{2t}$$

$$\frac{\varphi_2}{t}\left(1 - \frac{1}{4\varphi_2 t}\right) > 0 \tag{2. 17}$$

The second order condition confirms the result that the price in public facility has positive impact in price of private facility.

$$\frac{\partial p_2{}^{NN}}{\partial \widetilde{p_1}} = \frac{1}{2\left(1 - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2{}^{NN}}{\partial \widetilde{p_1}} > 0 \tag{2. 18}$$

The general specification for valid conclusions are that $p_2 > 0, \widetilde{p_1} \geq 0, \widetilde{q_1} \geq 0, t \geq 0, c_2 \geq 0$, and $\varphi_2 > 0$. This also applies for other propositions. The higher the government sets the price in public, the higher private provider will set the price. Private sector gives common response in dealing with the public price as part of the competition. By offering higher price, private sector still attracts patient because patients in the afternoon will definitely go to private provider. High price in private facility also implies a high level of quality in private facility as it is indicated in (2.15), so that there are patients who still visiting private facility in order to get high quality.

Proposition 2: *The price in private facility is negatively related with quality in public sector.*

Using the comparative statics of quality $\widetilde{q_1}$ by solving the second order conditions that confirmed in Appendix 2B.1, we can show that,

$$\frac{\partial p_2{}^{NN}}{\partial \widetilde{q_1}} = -\frac{1}{2\left(1 - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2{}^{NN}}{\partial \widetilde{q_1}} < 0 \tag{2. 19}$$

At the beginning of the decision stage, if the government sets the higher level of quality treatment in public facility, the private sector responses by lowering the price while it is assumed other things constant. The high level of quality in public sector must attract more patients, and private sector lowered the price in order to get more patients. The decreasing price might be followed with the decreasing quality, but in this case, the marginal profit by lowering the price is still attracts more patients and gives more profit for private provider.

Proposition 3: *The high (or low leve)l of price in the private sector is related with high (or low level) of patient's travel cost.*

The comparative statics (see Appendix 2B.1) shows that travel cost has positive relation with price of treatment in private facility.

$$\frac{\partial p_2{}^{NN}}{\partial t} = \frac{\left(3+\frac{c_2}{2\varphi_2 t^2}\right)2\left(1-\frac{1}{4\varphi_2 t}\right)-\left(3t-\widetilde{q_1}+\widetilde{p_1}+(1-\frac{1}{2\varphi_2 t})c_2\right)\left(\frac{1}{2\varphi_2 t^2}\right)}{\left(2\left(1-\frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2{}^{NN}}{\partial t} > 0 \qquad \textbf{(2. 20)}$$

The travel cost plays an essential role from the provider's perspective, and it must be greater than zero $t > 0$. The result shows that the higher the travel cost faced by the patient, the private sector decides to increase the price. As it is mentioned in the previous sub chapter, the *t* describes the location differentiation between patient and provider. This can be translated further into different aspects such as distance or travel cost. We use the last term for our purpose. High travel cost usually associates with far distance between patients from health care provider. It indicates that there is limited number of provider in the system hence the competition between provider is low and private provider can set higher price without losing attractiveness from patient.

Proposition 4: *The price of treatment will be set into high (low) level when the private facility has high (low) cost to provide treatment.*

The analysis on cost of treatment c_2 provides a proof that when private facility needs a higher cost to produce a treatment then the price level will be increasing. The relationship between price and cost is consistent with the standard economics. The increasing price is a logic respond from private providers when they have high cost level in order to keep the profit margin. Besides the direct relation to the price, the cost of treatment also has an indirect effect to the price. It goes through the quality of treatment, where cost of treatment moves into the same direction with the quality. The quality will increase as the price also increases. The comparative static to support the claim is following and the detailed process is on the Appendix 2B.1.

$$\frac{\partial {p_2}^{NN}}{\partial c_2} = \frac{\left(1 - \frac{1}{2\varphi_2 t}\right)}{2\left(1 - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial {p_2}^{NN}}{\partial c_2} > 0 \qquad \textbf{(2. 21)}$$

Proposition 5: *The cost of quality treatment in private facility has direct and indirect effects to the price in the private facility. The relation between cost of* *quality and price in private facility might be positive or negative depends on other parameter values.*

The difference effect appears for the cost of quality treatment, φ_2, that has indirect effect to the price through quality. The effect of φ_2 is closely related with other variables of $t, \widetilde{q_1}, \widetilde{p_1}$, and c_2. When the $\frac{1}{2}(3t - \widetilde{q_1} + \widetilde{p_1} + c_2) < c_2$, the increase in φ_2 will be followed with an increase on the price of the private provider ($\frac{\partial p_2}{\partial \varphi_2} > 0$**)**. When the $\frac{1}{2}(3t - \widetilde{q_1} + \widetilde{p_1} + c_2) > c_2$, an increase in φ_2 will be followed with a decrease in the on price of the private provider ($\frac{\partial p_2}{\partial \varphi_2} < 0$).

$$\frac{\partial {p_2}^{NN}}{\partial \varphi_2} = \frac{\left(\frac{c_2}{2{\varphi_2}^2 t}\right) 2\left(1 - \frac{1}{4\varphi_2 t}\right) - \left(3t - \widetilde{q_1} + \widetilde{p_1} + (1 - \frac{1}{2\varphi_2 t}) c_2\right)\left(\frac{1}{2{\varphi_2}^2 t}\right)}{\left(2\left(1 - \frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2}{\partial \varphi_2} <> 0 \qquad \textbf{(2. 22)}$$

The role of quality cost can be clearly interpreted using the original profit function in 2.13, ${\pi_{pv}}^{NN} = \frac{t - \widetilde{q_1} + \widetilde{p_1} + {q_2}^{NN} - {p_2}^{NN}}{2t}({p_2}^{NN} - c_2) + 1.({p_2}^{NN} - c_2) - \varphi_2 \frac{{{q_2}^{NN}}^2}{2}$. When cost of treatment equal to zero ($c_2 = 0$), and $\frac{\partial p_2}{\partial \varphi_2} < 0$, it means that the high cost of providing quality treatment makes private provider will have less net benefit because private provider cannot charge high price. The private provider prefers to expand quantity which has less cost of production (small value of φ_2). Patients will attract to this facility because it offers low price. The provider still gets profit from this additional increase of demand.

When cost of treatment is very high, the margin between price and cost $(p_2 - c_2)$ will be small and $\frac{\partial p_2}{\partial \varphi_2} > 0$. The private provider prefers not producing more services because of high cost. The facility chooses to set high price in order to get better profit margin. The increasing cost associates with the increasing quality level so that private facility still attract patients who are concerned with the quality rather than price. On the other hand, the increasing price potentially causes a decrease in number of patients, but the losing demand is not as important as when cost of treatment is equal to zero $(c_2 = 0)$ because provider has already get better margin from the increasing price.

2.3.2 Price in private provider when dual practice is not allowed but an insurance scheme does exist

In the second case, we introduce an additional variable to measure the effect of insurance. We take the basic idea of insurance that patient shares the financial risk to the other party. When insurance scheme exists in health care system, it means that patient will not pay full treatment fee to health care provider, but the insurance company reimburses a part of treatment fee instead. We define s as proportion of treatment fee that will be paid by the patient, the $(1 - s)$ is the proportion of treatment fee paid by insurance company. The $s=0$ implies that patient gets full coverage from insurance coverage, while $s=1$ means no insurance coverage or patient has to pay the entire treatment fee by himself. We simplify the role of insurance by focusing on the reimbursement mechanism by insurance company and ignoring neither the premium payment mechanism nor the individual preference to involve in any insurance scheme.

We compose the profit function in private provider by putting the demand function with the insurance variable, s, in it. The s attaches with price component whether it is the price of public provider or price of private provider.

$$\pi_{pv}{}^{NI} = D_2^{am}(p_2{}^{NI}, \widetilde{p_1}, q_2{}^{NI}, \widetilde{q_1})(p_2{}^{NI} - c_2) + D_2^{pm}(p_2{}^{NI}, q_2{}^{NI})(p_2{}^{NI} - c_2) - \varphi_2 \frac{q_2{}^{NI^2}}{2}$$

$$\pi_{pv}{}^{NI} = x_2{}^{am}(p_2{}^{NI} - c_2) + x_2{}^{pm}(p_2{}^{NI}, q_2{}^{NI})(p_2{}^{NI} - c_2) - \varphi_2 \frac{q_2{}^{NI^2}}{2}$$

$$\pi_{pv}{}^{NI} = \frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} - sp_2{}^{NI}}{2t}(p_2{}^{NI} - c_2) + 1.(p_2{}^{NI} - c_2) - \varphi_2 \frac{q_2{}^{NI^2}}{2} \qquad \textbf{(2. 23)}$$

Solving the set of first order conditions by setting $\frac{\partial \pi_{pv}{}^{NI}}{\partial p_2{}^{NI}} = 0$ and $\frac{\partial \pi_{pv}{}^{NI}}{\partial q_2{}^{NI}} = 0$, we get the solution of price in private facility as (see Appendix 2A.3)

$$p_2{}^{NI} = \frac{3t - \widetilde{q_1} + s\widetilde{p}_1 + (s - \frac{1}{2\varphi_2 t})c_2}{2\left(s - \frac{1}{4\varphi_2 t}\right)} \qquad \textbf{(2. 24)}$$

$$q_2{}^{NI} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} - sc_2}{4s\varphi_2 t - 1} \qquad \textbf{(2. 25)}$$

Proposition 6: *The equilibrium price in the private facility is higher for more insurance coverage.*

The value of s must be between zero and 1, $0 < s \leq 1$. We analyze how insurance role in price determination of private provider. By finding the comparative statics (see Appendix 2B.2)as follows:

$$\frac{\partial p_2{}^{NI}}{\partial s} = \frac{(\widetilde{p_1} + c_2)2\left(s - \frac{1}{4\varphi_2 t}\right) - 2\left(3t - \widetilde{q_1} + s\widetilde{p_1} + (s - \frac{1}{2\varphi_2 t})c_2\right)}{\left(2\left(s - \frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2{}^{NI}}{\partial s} < 0 \tag{2. 26}$$

The result shows that the less insurance will be followed by the decreasing price in private provider or in other words, the increasing level of patient's insurance, the higher the private sets the price. The general conditions for the results are $p_2 > 0, \widetilde{p_1} \geq 0, \widetilde{q_1} \geq 0, t \geq 0, c_2 \geq 0, \varphi_2 > 0$, and $0 < s \leq 1$.

We provide simple simulation in Figure 2.3 to show the role of insurance in the system. In this point, we have no guidance to set the values for the simulation. There is no definition on how variables involved in our model will be measured in real life nor a certain scale for each variable. The main goal in doing simulation is to assert this possibility exists and no claims about the empirical facts. The simulation uses the solution of price in private facility. The point A indicates low insurance coverage so that the private provider sets low price. The point B indicates high level of insurance coverage and private facility will have high price. As the percentage of treatment fee covered by insurance is increasing, the price is slowly increasing. The figure in 2.3 uses fixed values of $c_2 = 1, \varphi_2 = 1, t = 5, 0.1 \leq s \leq 1, \widetilde{p_1} = 1, \widetilde{q_1} = 0.1$ but in general the results do not depend on the selected sets of values as long as we keep $p_2 > 0, \widetilde{p_1} \geq 0, \widetilde{q_1} \geq 0, t \geq 0, c_2 \geq 0$, $\varphi_2 > 0$, and $0 < s \leq 1$ also second order conditions are hold.

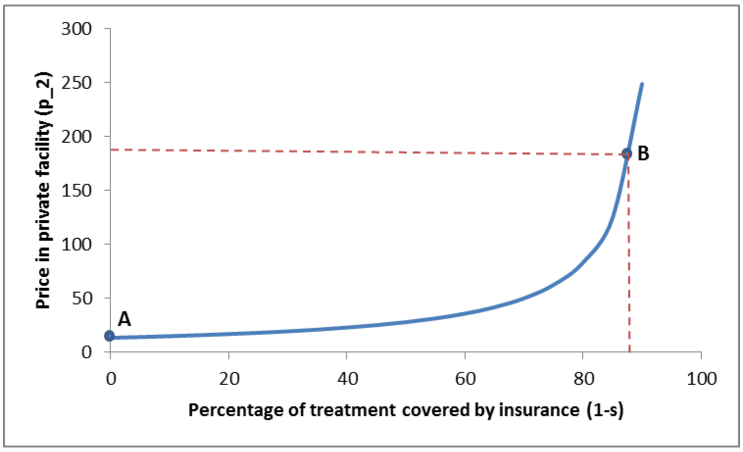


Figure 2. 3 Price and Insurance Relationship

The more s towards one, $0 < s \leq 1$ that indicates people are having less insurance, the price of private facility will be decreased. The result implies that the more insurance covers the treatment fee, the private provider will set higher price. The result in 2.6 holds for general cases.

Proposition 7: *The price of treatment in private facility under no dual practice-with insurance (NI) is related in the same way with the remaining variables such as price of public facility, quality of public, cost of treatment in private and cost of quality treatment in private sector as in the previous case of no dual practice-no insurance in the system (NN).*

The detailed proof using second order conditions is available in the Appendix. The price in public sector has important effect on the price setting by private facility. Private facility reacts into same direction with the price in public facility set by health authority. The increasing public quality leads to the decreasing level of price by private sector. This behavior can be translated that price is not the only component that involve in the competition between public and private sector. Private sectors still might attract patients although they provide treatment with higher price and offer higher quality of treatment. In the sub chapter of 2.4 that specifically discussing on quality determination, we will provide the detailed relationship between price and quality.

The cost components which are cost of treatment and cost of quality give the same direction as previous regime. The explanation will be straightforward that when facility provides treatment with the higher cost, the direct consequence to maintain the revenue is by increasing the price. The cost of quality might have positive or negative relation with the price depends on which variable that has higher domination among others.

2.3.3 Price in private provider when dual practice is allowed but an insurance scheme does not exist

Dual practice existence in health care system allows people to have more options regarding health care provider. In the morning working hours, people can only choose between public and private provider, but in the afternoon, people now can choose private provider with dual practice physician (we call it dual practice facility for short) and private provider with private physician (private facility).

The profits function in private facility that consists of morning and afternoon demand is

$$\pi_{pv}{}^{DN} = D_2^{am}(p_2{}^{DN}, \widetilde{p_1}, q_2{}^{DN}, \widetilde{q_1})(p_2{}^{DN} - c_2)$$
$$+ D_2^{pm}(p_2{}^{DN}, p_1{}^{DN}, q_2{}^{DN}, q_1{}^{DN})(p_2{}^{DN} - c_2)$$
$$- \varphi_2 \frac{q_2{}^{DN^2}}{2}$$

$$\pi_{pv}{}^{DN} = x_2{}^{am}(p_2{}^{DN} - c_2) + x_2{}^{pm}(p_2{}^{DN} - c_2) - \varphi_2 \frac{q_2{}^{DN^2}}{2}$$

$$\pi_{pv}{}^{DN} = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DN} - p_2{}^{DN}}{2t}(p_2{}^{DN} - c_2)$$
$$+ \frac{t - q_1{}^{DN} + p_1{}^{DN} + q_2{}^{DN} - p_2{}^{DN}}{2t}(p_2{}^{DN} - c_2)$$
$$- \varphi_2 \frac{q_2{}^{DN^2}}{2} \qquad \textbf{(2. 27)}$$

The profit in private-dual practice that consists of afternoon demand only is,

$$\pi_{pv(DP)}{}^{DN} = D_1^{pm}(p_2{}^{DN}, p_1{}^{DN}, q_2{}^{DN}, q_1{}^{DN})(p_1{}^{DN} - c_1) - \varphi_1 \frac{q_1{}^{DN^2}}{2}$$

$$\pi_{pv(DP)}{}^{DN} = x_1{}^{pm}(p_1{}^{DN} - c_1) - \varphi_1 \frac{q_1{}^{DN^2}}{2}$$

$$\pi_{pv(DP)}{}^{DN} = \frac{t + q_1{}^{DN} - p_1{}^{DN} - q_2{}^{DN} + p_2{}^{DN}}{2t}(p_1{}^{DN} - c_1)$$
$$- \varphi_1 \frac{q_1{}^{DN^2}}{2} \qquad \textbf{(2. 28)}$$

The $\widetilde{p_1}$ and $\widetilde{q_1}$ represent the price and quality in public facility. While the price and quality for private facility are ${p_2}^{DN}$ and ${q_2}^{DN}$. The new components that appear in this scheme and not in the previous two schemes are the components of price and quality in dual practice facility, ${p_1}^{DN}$ and ${q_1}^{DN}$. The rest of variables represent cost components, such as travel cost to facility, t, cost of providing treatment in private facility and dual practice facility, c_2 and c_1. We assume that the cost of providing treatment in dual practice facility is similar with cost of providing treatment in public facility, hence we use the same symbol of c_1. The cost of quality treatment in private and dual practice facility are $\varphi_2$and φ_1. The same case with cost of treatment, the cost of quality treatment in dual practice is equal with in public facility, hence we use the equal symbol of $\varphi_1$for both facilities. The assumption is based on the fact that we model the dual practice facility as a private practice that located in the same location as public facility with the same public physician. Hence the cost of producing treatment with certain level of quality might be the same with the cost of providing treatment in public provider.

We solve the solution of the price in private facility, ${p_2}^{DN}$, by finding its equilibrium and setting$\frac{\partial {\pi_{pv}}^{DN}}{\partial {p_2}^{DN}} = 0,\ \frac{\partial {\pi_{pv}}^{DN}}{\partial {q_2}^{DN}} = 0, \frac{\partial {\pi_{pv(DP)}}^{DN}}{\partial {p_1}^{DN}} = 0, \frac{\partial {\pi_{pv(DP)}}^{DN}}{\partial {q_1}^{DN}} = 0$. The result also provides solution for the price in the dual practice facility, ${p_1}^{DN}$. We focus on analyzing the price in the private facility, ${p_2}^{DN}$ so that the result can be compared with the result from other regimes, but we provide the complete works of ${p_1}^{DN}$ in the Appendix. The solution of price in private facility:

$$p_2^{DN} = \frac{\Big(2t - \widetilde{q_1} + \widetilde{p_1} + \Big(1 - \frac{1}{\varphi_2 t}\Big) 2c_2 + \frac{c_1}{2\varphi_1 t}\Big)\Big(2 - \frac{1}{2\varphi_1 t}\Big) + \Big(t + \Big(1 - \frac{1}{2\varphi_1 t}\Big) c_1 + \frac{c_2}{\varphi_2}}{\Big(2 - \frac{1}{2\varphi_1 t}\Big) 2 \Big(2 - \frac{1}{\varphi_2 t}\Big) - \Big(1 - \frac{1}{2\varphi_1 t}\Big)\Big(1 - \frac{1}{\varphi_2 t}\Big)}$$

(2. 29)

The solution of price in dual practice facility (see Appendix 2A.5) is:

$$p_1^{DN} = \\ = \frac{\Big(2t - \widetilde{q_1} + \widetilde{p_1}\Big(1 - \frac{1}{\varphi_2 t}\Big) 2c_2 + \frac{c_1}{2\varphi_1 t}\Big)\Big(1 - \frac{1}{\varphi_2 t}\Big) + \Big(t + \Big(1 - \frac{1}{2\varphi_1 t}\Big) c_1 + \frac{c_2}{\varphi_2 t}\Big) 2 \Big(2 - \frac{1}{\varphi_2 t}\Big)}{\Big(2 - \frac{1}{2\varphi_1 t}\Big) 2 \Big(2 - \frac{1}{\varphi_2 t}\Big) - \Big(1 - \frac{1}{2\varphi_1 t}\Big)\Big(1 - \frac{1}{\varphi_2 t}\Big)}$$

(2. 30)

Proposition 8: *The price in private facility under the dual practice-without insurance scheme (DN) is affected by variables of price in public, quality in public, travel cost, cost of treatment, and cost of quality in the same direction as the relation in the no dual practice-no insurance regime (NN).*

The detailed comparative statics are presented in the Appendix 2B.3. It is confirmed using second order condition that the increasing price in public facility will be followed with the increasing price in private sector under dual practice-without insurance scheme. The additional facility in the afternoon which is dual practice facility allows patients to choose between private facility and dual practice facility. But the options are still the same for the health facility in the morning which is between public facility and private facility. The price setting for the private facility comes from single price equilibrium so that the price for private facility in the morning working hours will be the same with the price in private facility in the afternoon working hours. The general conditions to guarantee the consistency of the results are $p_2 > 0, p_1 > 0, \widetilde{p_1} \geq 0, \widetilde{q_1} \geq 0, t \geq 0, c_2 \geq 0, c_1 \geq 0$, $\varphi_2 > 0$, φ_1 and $0 < s \leq 1$.

Remark 1: *The price in dual practice facility under the dual practice-without insurance scheme (DN) positively relates with the price in public facility that is set by health authority in the beginning of the game. The comparison between price in dual practice and price in private facility shows that in general price in private facility will have higher price compare to price of treatment in dual practice facility although in some cases the comparison shows the contrary. The results will depend on the other variables that appear in the model.*

The price in dual practice facility has indirect relation with the public price facility through price in private facility because from the demand formation, the dual practice facility only competes with private facility in the afternoon. The increasing price in public facility will be responded with the increasing price in private facility. This situation will impact the equilibrium price in dual practice facility.

The Figure 2.4 uses fixed variables of $c_1 = c_2 = 1, \varphi_1 = \varphi_2 = 1, t = 5, 0 \leq \widetilde{p_1} \leq 100, \widetilde{q_1} = 0.1$ to show the comparison between price in private facility (${p_2}^{DN}$) and dual practice facility (${p_1}^{DN}$) along with the increasing value of price in public, $\widetilde{p_1}$. Both prices are increasing along with the increasing value of price in public facility. In the afternoon, the demand of private facility is decreasing as the price in private goes up. People might favor dual practice facility so that demand of dual practice is increasing although the price in dual practice is going up but not as fast as the increasing price in private provider. The difference phase of changing demand and price between private facility and dual practice facility cause the price in dual practice is higher than the price in private facility in the beginning but after sometimes the price in private facility becomes much higher than the price in dual practice.

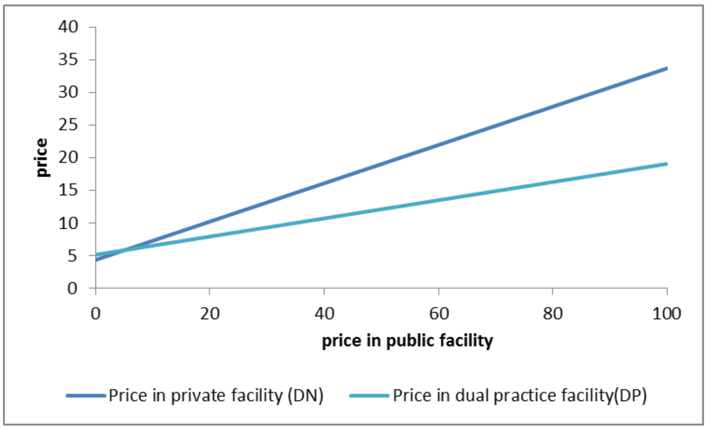


Figure 2. 4 The comparison between price in dual practice facility and price in private facility

2.3.4 Price in private provider when dual practice is allowed and an insurance scheme does exist

The last case in our framework is the situation where there are dual practice physician and insurance coverage in the system. The dual practice allows patient in the afternoon to choose between private facility with dual practice physician (dual practice facility) and private facility with private physician (private facility). The insurance component, s, represents the proportion of treatment fee that been paid individually to the health care facility by the patient. The $(1-s)$ represents the insurance coverage that will relieves a proportion of treatment fee paid by patient. The value of s is between zero and one, $0 < s \leq 1$.

The profit function for each provider in this scenario is the additional form of profit in the morning and profit in the afternoon as appeared before in the previous regimes, but now we include insurance component in demand function and dual practice facility option in the afternoon working hours. In the morning, the private facility will provide treatments together with the public provider, while in the afternoon private facility and dual practice facility are the providers that will serve the patients. The profit function for the private facility is,

$$\pi_{pv}{}^{DI} = D_2^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})({p_2}^{DI} - c_2) + D_2^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})({p_2}^{DI} - c_2) - \varphi_2 \frac{{q_2}^{DI^2}}{2}$$

$$\pi_{pv}{}^{DI} = {x_2}^{am}({p_2}^{DI} - c_2) + {x_2}^{pm}({p_2}^{DI} - c_2) - \varphi_2 \frac{{q_2}^{DI^2}}{2}$$

$$\pi_{pv}{}^{DI} = \frac{t - \widetilde{q_1} + s\widetilde{p_1} + {q_2}^{DI} - s{p_2}^{DI}}{2t}({p_2}^{DI} - c_2) + \frac{t - {q_1}^{DI} + s{p_1}^{DI} + {q_2}^{DI} - s{p_2}^{DI}}{2t}({p_2}^{DI} - c_2) - \varphi_2 \frac{{q_2}^{DI^2}}{2} \quad \textbf{(2. 31)}$$

The next is the profit function of dual practice facility that consists of afternoon demand because it only opens in the afternoon working hours.

$$\pi_{pv(DP)}{}^{DI} = D_1^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})({p_1}^{DI} - c_1) - \varphi_1 \frac{{q_1}^{DI^2}}{2}$$

$$\pi_{pv(DP)}{}^{DI} = {x_1}^{pm}({p_1}^{DI} - c_1) - \varphi_1 \frac{{q_1}^{DI^2}}{2}$$

$$\pi_{pv(DP)}{}^{DI} = \frac{t + {q_1}^{DI} - s{p_1}^{DI} - {q_2}^{DI} + s{p_2}^{DI}}{2t}({p_1}^{DI} - c_1) - \varphi_1 \frac{{q_1}^{DI^2}}{2} \qquad \textbf{(2. 32)}$$

The $\widetilde{p_1}$ is a public price, $\widetilde{q_1}$ is a treatment quality in public, p_2 and q_2 are price and quality treatment in private facility, c_2 is treatment cost in private facility, s is the percentage of treatment fee that paid by the patient, t is travel cost, and φ_2 is quality cost in the private facility. The p_1 and q_1 are price and quality treatment in dual practice facility. The c_1 and φ_1 are cost of treatment and quality cost in private-dual practice facility. The price equilibrium is obtained by defining $\frac{{\pi_{pv}}^{DI}}{\partial {p_2}^{DI}} = 0$, $\frac{{\pi_{pv}}^{DI}}{\partial {q_2}^{DI}} = 0$, $\frac{{\pi_{pv(DP)}}^{DI}}{\partial {p_1}^{DI}} = 0$, $\frac{{\pi_{pv(DP)}}^{DI}}{\partial {q_1}^{DI}} = 0$. The solution of price in private facility is obtained using the same way as in the previous regime. We provide the complete work in the Appendix 2A.7. The solution of the price in private facility is:

$$p_2{}^{DI} = \frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right)\right.}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)}$$

(2. 33)

Here we directly put the result for the solution of price in dual practice facility while the step by step solution is available in the Appendix 2A.7.

$$p_1{}^{DI} = \frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right) c_1 + \right.}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)}$$

(2. 34)

Proposition 9: *Under dual practice-with insurance scheme (DI), the variable of price in public facility has the positive relationship with the price in private facility, while the quality of public facility has negative relation with the price of private facility.*

Using a comparative statics (Appendix 2B.4) to see how the price in public, $\widetilde{p_1}$, affects the price in private while other things remind the same. The result is the same as in the rest of the case, $\frac{\partial p_2{}^{DI}}{\partial \widetilde{p_1}} > 0$, where the increasing of public price set by government is followed by the increasing price in private.

$$\frac{\partial p_2{}^{DI}}{\partial \widetilde{p_1}} = \frac{s\left(2s - \frac{1}{2\varphi_1 t}\right)}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)}$$

$$\frac{\partial p_2{}^{DI}}{\partial \widetilde{p_1}} > 0 \qquad \textbf{(2.35)}$$

The comparative statics of quality in public provider shows that whenever the quality in public provider goes up, the price in private facility goes down, $\frac{\partial p_2{}^{DI}}{\partial \widetilde{q_1}} < 0$.

$$\frac{\partial p_2{}^{DI}}{\partial \widetilde{q_1}} = -\frac{\left(2s - \frac{1}{2\varphi_1 t}\right)}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)}$$

$$\frac{\partial p_2{}^{DI}}{\partial \widetilde{q_1}} < 0 \qquad \textbf{(2.36)}$$

Proposition 10: *The variables under dual practice-with insurance regime (DI) such as the price of public facility, $\widetilde{p_1}$, the quality of treatment in public facility, $\widetilde{q_1}$, travel cost, t, insurance coverage, s, have the similar effect to the price of private facility under no dual practice-without insurance regime (NI).*

The travel cost measures the distance of patient from the facility. It shows that the higher the cost to travel to the facility, the private provider will set higher price. The comparative statics is $\frac{\partial p_2{}^{DI}}{\partial t} > 0$, the detailed formulation is in Appendix 2B.4. We assume that travel cost is positively related with travel distance to health facility. It can be interpreted as the scarcity of facility so that patient needs to go far distance to get treatment. The facility has higher bargaining position to determine higher price level. The travel cost shows identical behavior in affecting price setting in private facility. Under dual practice and insurance regime, the travel cost has positive relationship with the price of private facility.

The insurance ownership by the patient that indicates the insurance existence in the system leads to the increasing price in private facility. In our model, the s is the part of treatment fee paid by the patient, while the $(1-s)$ is the percentage of treatment fee paid by insurance company. Using insurance term, this mechanism is also known as copayment. The result shows the comparative statics of s, $\frac{\partial {p_2}^{DI}}{\partial s} < 0$. The complete equation of insurance comparative statics is available in the appendixes. The more insurance coverage available for patients, the price level in private facility will go up.

The cost components in the model are cost of treatment and cost of quality treatment. The first one relates with a unit cost to provide a single treatment in the facility, while the latter is the cost associated with the quality level. The cost of treatment has a positive relationship, $\frac{\partial {p_2}^{DI}}{\partial c_2} > 0$, the more costly the cost to produce a unit of treatment, the higher a private facility sets its price. The cost of quality indicates the relationship with the price has both directions, $\frac{\partial {p_2}^{DI}}{\partial \varphi_2} <> 0$. The positive or negative relationship depends on other variables involved, particularly the travel cost, price in public, and quality in public. The increasing cost of quality treatment makes private facility to increase the price. The number of patients might decrease because of this increasing price. In this case, the cost of quality has a positive relationship with the price. In order to recover the demand level, the private facility might reduce the price although the cost of quality is still high. The provider might think that regaining demands level will have larger profit margin compare to profit margin from the increasing price. In this case the relationship between quality treatment cost and the price is negative. But in general, the cost components behave exactly as expected, the more cost needed to produce a particular treatment then the price of treatment will increase.

2.4 Quality of treatment

The quality of treatment in public facility, private facility, and dual practice facility will be discussed in this sub chapter. In general, quality is related with price and cost components such as cost of treatment and cost of quality, and travel cost. The solution of quality is solved simultaneously with the solution of price. From equation (2.15), the quality of treatment in the situation of no dual practice and no insurance is,

$$q_2{}^{NN} = \frac{p_2 - c_2}{2\varphi_2 t} \qquad \textbf{(2. 37)}$$

The solution of price in quality treatment is obtained by substituting the p_2 in above expression using p_2 solution in each scenario. The price has important role in the quality determination and it shows that the price and quality moves in the same direction. The other three variables are characterized the cost variables in quality and moves in different direction, as the cost increase, the quality will decrease. The cost component underlines the fact that the more costly to produce the treatment, the cost will directly reduce the quality. The quality is a direct reaction of private sector to compensate the increasing price.

We show the complete solution of quality for each scheme in the Appendix of 2A.2, 2A.4, 2A.6, and 2A.8. We write the final result in this sub chapter by adding the superscript to differentiate situation of no dual practice-no insurance (NN), no dual practice-with insurance (NI), dual practice-no insurance (DN), and dual practice-insurance (DI). The q_2 solution in the case without dual practice or insurance in the system$({q_2}^{NN})$ is,

$$
{q_2}^{NN} = \frac{\dfrac{3t - \widetilde{q_1} + \widetilde{p_1} + (1 - \frac{1}{2\varphi_2 t})c_2}{2\left(1 - \frac{1}{4\varphi_2 t}\right)} - c_2}{\varphi_2 t}
$$

The expression can be written in simpler form:

$$
{q_2}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} - c_2}{4\varphi_2 t - 1} \tag{2. 38}
$$

We show the positive relationship between price and quality in no dual practice-no insurance regime in Figure 2.5. The pattern also appears in quality in private provider for the rest of three regimes.

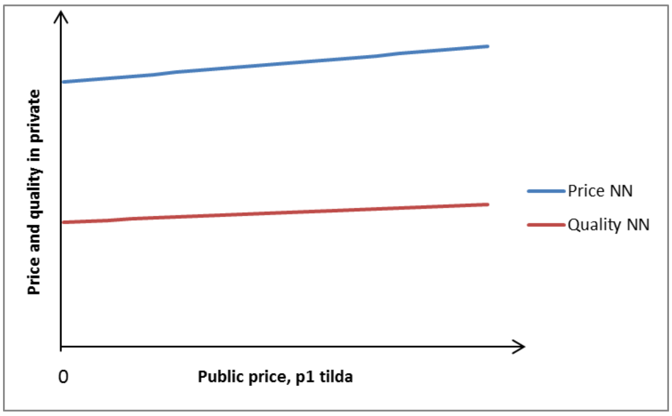


Figure 2. 5 Price in public and price in private

Using the same method, the quality for the private facility without dual practice but under insurance scheme in the system, ${q_2}^{NI}$, is:

$$ {q_2}^{NI} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} - sc_2}{4s\varphi_2 t - 1} \quad \textbf{(2. 39)} $$

The quality of private facility with dual practice but without insurance (${q_2}^{DN}$) is:

$$ {q_2}^{DN} = \frac{\left(2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t}\right)\left(1 - \frac{1}{2\varphi_1 t}\right) - c_2\left(\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right)}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right] \varphi_2 t} $$

(2. 40)

The last solution is the quality of private facility when there is dual practice and insurance, ${q_2}^{DI}$,

$$q_2{}^{DI} = \frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t}\right)\left(s - \frac{1}{2\varphi_1 t}\right) - c_2\left(\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right)}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]\varphi_2 t} \tag{2.41}$$

Proposition 11: *Quality of treatment in private facility is positively related to price.*

In general, the quality of treatment is determined by the level of price in private provider. A high price means that private provider has more incentive to provide treatment with high quality. The decreasing price on the other hand makes private facility to reduce the level of quality treatment. The mechanism describes rational decision of private provider to maintain the profit while considering the quality level. The high price in private provider might reduce patient’s interest to visit the facility. In order to maintain the number of patients, the private provider has to increase the level of quality. Hence some patients still consider coming to private facility although price is high, especially patients who think that quality of treatment is matter and they still can afford it.

The relationship between quality of treatment and the price is showed in Figure 2.6. It describes the quality in private under four regimes. In this simulation, we set all variables constant except the price in public facility. From the previous chapter, we have already concluded that the price in private facility is positively related with the price in public. Whenever there is an increasing or decreasing price in public provider, it will be followed with the increasing or decreasing price in private facility. From the Proposition 11, the quality in private facility is affected by its price. These two connections imply that the increasing price in public facility leads to the increasing quality in private sector. Private facility gives similar reaction under four regimes. In the graph, we set the values of $c_1 = c_2 = 1, t = 100, s = 0.5, \varphi_1 = \varphi_2 = 1; 0 \leq \widetilde{p_1} \leq 100.$

The Figure 2.6 shows that the first regime of no dual practice-no insurance (NN) has the lowest level of quality treatment among others. While the highest level of quality treatment is at the dual practice with insurance regime (DI). Although this is not the general conclusion for the comparison among four regimes, the result in Figure 2.6 can be explained as follows. Private facility might charge high price when insurance coverage is in the system. The more competitive situation under dual practice regime can be considered by the private facility to reduce the price. But in this case the increasing price from the insurance effect gains more so that private provider will set high level of quality and patients still eager to visit private provider.

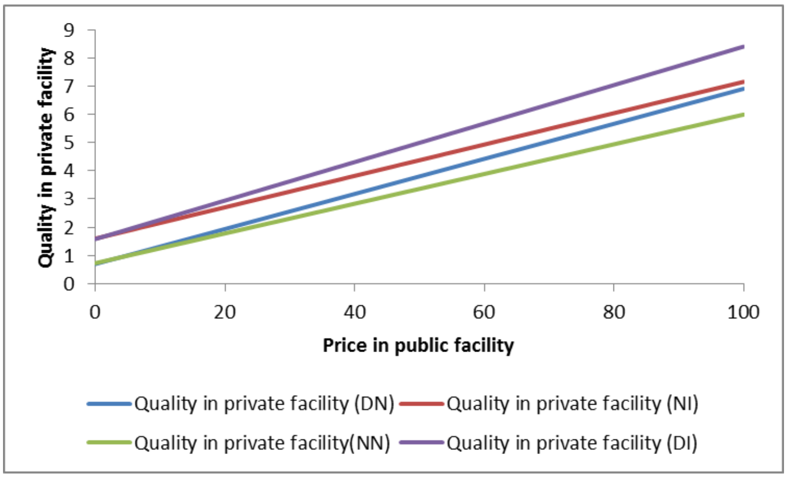


Figure 2. 6: Quality in private and price in public under four regimes

Remark 2: *Introducing dual practice to the system irrespective of existence of insurance might increase or decrease quality of treatment.*

We provide proof for the Remark 2 by finding the difference between quality in the system with and without insurance.

$$({q_2}^{DI} - {q_2}^{NI}) - ({q_2}^{DN} - {q_2}^{NN})$$

$$= \left[\left(\frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right)2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right)c_1 + \frac{c_2}{\varphi_2 t}\right)\left(s - \frac{1}{2\varphi_1 t}\right) - c_2\left(\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right)}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]\varphi_2 t}\right)\right.$$

$$\left. - \left(\frac{3t - \widetilde{q_1} + s\widetilde{p_1} - sc_2}{4s\varphi_2 t - 1}\right)\right]$$

$$- \left[\left(\frac{\left(2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right)2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(1 - \frac{1}{2\varphi_1 t}\right)c_1 + \frac{c_2}{\varphi_2 t}\right)\left(1 - \frac{1}{2\varphi_1 t}\right) - c_2\left(\left(2 - \frac{1}{2\varphi_1 t}\right)2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right)}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right)2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]\varphi_2 t}\right)\right.$$

$$\left. - \left(\frac{3t - \widetilde{q_1} + \widetilde{p_1} - c_2}{4\varphi_2 t - 1}\right)\right]$$

(2. 42)

The result simulation shows that the difference might be larger or smaller than zero. Moving into dual practice situation when the system available is already with or without insurance has positive or negative consequence to quality of treatment. The level of quality might be higher or lower along with the introduction of dual practice.

2.5 Welfare effects in the long run

We have mentioned in the earlier sub chapter that our framework of access involves dual practice and insurance coverage as physical ability and financial affordability. However in our timelines decision, we focus on the patient and physician relationship under dual practice regime and insurance coverage. To justify which regime performs better among the other, we compose a standard welfare analysis in the long run and short run. In general we calculate the sum of surplus from all agents involved in the framework.

The first agent in the model is the patient. The surplus of patient is the total utility of patient from getting treatment when visiting one of health care facilities. The crucial element in the dual practice regime is that dual practice creates competitor of health care providers. We differentiate demand of treatment based on the opening hours, morning working hours and afternoon working hours for easier interpretation.

The second agent is related with health care facility that represent physician's working place between public facility, private facility, and dual practice facility. The surplus of health facility is a profit function from each facility that involved in each regime by considering demand from each working hours. When dual practice physician allowed in the system, the available facilities in the morning are public facility and private facility while in the afternoon the available facilities are private facility and dual practice facility. When dual practice is not allowed in the system, the available options in the morning are public facility or private facility while in the afternoon consists of private facility only.

The next agent is the insurance company and government. We model the insurance scheme as a subsidized insurance provided by the government. The insurance company will pay a percentage amount of treatment fee to health care facility and receive the exact reimbursement from the government. Hence the insurance company is in null state. The government will transfer the amount of treatment fee directly to insurance company only when the insurance scheme exists in the system. We assume that the government has sufficient budget for covering the insurance subsidy and transfer to the insurance company. Our study will not look further into how government collecting funds to finance the insurance, for example trough taxation. The limitation has main purpose for the simplification of the study. When we refer back to our time line decision, it is clear that our study starts with health authority decision on dual practice regulation without mentioning funding mechanism.

We construct the welfare function to compare four conditions of dual practice and insurance combination: no dual practice-no insurance (NN), no dual practice-insurance (NI), dual practice-no insurance (DN), and dual practice-insurance (DI). The welfare effect in the long run, is a function of economic variables that are involved in the system. The construction involves the adjusted price and the adjusted quality in the equilibrium state. We assume that in the long run, the private sector has enough time to adapt the price and its quality after the government sets the price and quality in the public sector.

The welfare function measures total benefit and cost of six elements in the system: patient in the morning, patients in the afternoon, the private facility, the public facility, insurance company and government transfers. We will discuss the welfare function in the long run for each condition of dual practice and insurance in sub chapter of 2.5.1 to sub chapter 2.5.4. The sub chapter 2.5.5 provides the interpretations.

2.5.1 The long run welfare effect of no dual practice-no insurance

The total welfare function of no dual practice and no insurance is the summation of six elements in the system:

$$\begin{aligned} &total\ welfare(NN) \\ &\qquad = welfare\ of\ patient\ in\ the\ morning \\ &\qquad + welfare\ of\ patient\ in\ the\ afternoon \\ &\qquad + welfare\ of\ private\ facility + welfare\ of\ public\ facility \\ &\qquad + welfare\ of\ insurance\ company - government\ transfer \end{aligned}$$

(2. 43)

The welfare function of patient is a patient utility from getting treatment in the health care facility. In the condition of no dual practice without insurance, the welfare function of the patient in the morning is patient's utility from getting treatment in public and private facility.

$$\begin{aligned} &Welfare\ of\ patient\ in\ the\ morning \\ &\qquad = \int_0^{{x_1}^{am}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx \\ &\qquad + \int_{{x_1}^{am}}^1 (y + {q_2}^{NN} - {p_2}^{NN} - t(1-x))dx \end{aligned}$$

(2. 44)

The first part consists of several variables, y is the individual patient income, the $\widetilde{q_1}$ is quality in public facility, $\widetilde{p_1}$ is price in public facility, t is the travel cost, and x is a distance to facility. The second part consists of $p_2{}^{NN}$ and $q_2{}^{NN}$ which are price and quality in private facility.

In the case of no dual practice, the patient only visits the private facility in the afternoon. Patient's welfare comes from the benefit of getting treatment in the afternoon from a private facility.

$$welfare\ of\ patient\ in\ the\ afternoon = \int_0^1 (y + q_2{}^{NN} - p_2{}^{NN} - t(1-x))dx \quad \textbf{(2. 45)}$$

The next welfare component comes from provider's welfare. It counts benefit and cost from the health care facility, public and private provider. We include the profit function from each facility. The function is basically the total revenue of price subtracted with the cost to provide treatment and multiplied with the quantity which describes the number of patients but in this case we use the demand of care. The other cost component is the cost related to the quality. Each provider's welfare involves all demands related to each facility based on provider's opening hours. The public facility uses the demand of public facility in the morning, while the private facility uses demand of private facility in the morning and in the afternoon.

$$welfare\ of\ private\ facility$$

$$= \int_{x_1{}^{am}}^{1} D_2^{am}(p_2{}^{NN}, \widetilde{p_1}, q_2{}^{NN}, \widetilde{q_1})(p_2{}^{NN} - c_2)dx$$

$$+ \int_0^1 1.(p_2{}^{NN}, q_2{}^{NN})(p_2{}^{NN} - c_2)dx - \varphi_2 \frac{q_2{}^{NN^2}}{2} \quad \textbf{(2. 46)}$$

$$welfare\ of\ public\ facility$$

$$= \int_0^{x_1{}^{am}} D_1^{am}(p_2{}^{NN}, \widetilde{p_1}, q_2{}^{NN}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx$$

$$- \varphi_1 \frac{\widetilde{q_1}^2}{2} \quad \textbf{(2. 47)}$$

The insurance company welfare function is null in this case as the insurance does not exist in this regime. So that the insurance company will not receive subsidy or pay treatment fee to health care facility.

The last part of welfare function is government transfer. In our model, the government is a party who will pay the percentage of treatment fee as an insurance scheme to insurance company. In the first case of no dual practice-no insurance, there is no insurance coverage and the government transfers zero amount to insurance company. The detailed explanation of insurance company role and government transfer will be appeared in the next sub chapter of no dual practice-with insurance scheme.

We rewrite the total welfare as the summation of all the components as:

$$
\begin{aligned}
&total\ welfare(NN)\\
&= \int_0^{x_1^{am}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx\\
&+ \int_{x_1^{am}}^1 \big(y + q_2{}^{NN} - p_2{}^{NN} - t(1-x)\big)dx\\
&+ \int_0^1 (y + q_2{}^{NN} - p_2{}^{NN} - t(1-x))dx\\
&+ \left(\int_{x_1^{am}}^1 D_2^{am}(p_2{}^{NN}, \widetilde{p_1}, q_2{}^{NN}, \widetilde{q_1})(p_2{}^{NN} - c_2)dx\right.\\
&\left.+ \int_0^1 1.(p_2{}^{NN}, q_2{}^{NN})(p_2{}^{NN} - c_2)dx - \varphi_2 \frac{q_2{}^{NN^2}}{2}\right)\\
&+ \left(\int_0^{x_1^{am}} D_1^{am}(p_2{}^{NN}, \widetilde{p_1}, q_2{}^{NN}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx\right.\\
&\left.- \varphi_1 \frac{\widetilde{q_1}^2}{2}\right)
\end{aligned}
\qquad \textbf{(2. 48)}
$$

2.5.2 The long run welfare effect of no dual practice-insurance

The welfare function of the second regime of no dual practice-with insurance (NI) has a similar form of total welfare function with the first regime, no dual practice-no insurance (NN). The difference mainly occurs on the additional insurance variable, *s*, which attaches to the price variable. The other distinction is on the government transfer where in the existence of insurance coverage, the government will transfer a certain percentage from total treatment fee to the insurance company as a subsidized insurance scheme.

The total welfare under no dual practice-with insurance scheme is:

$$\begin{aligned} & total\ welfare(NI) \\ & \quad = welfare\ of\ patient\ in\ the\ morning \\ & \quad + welfare\ of\ patient\ in\ the\ afternoon \\ & \quad + welfare\ of\ private\ facility + welfare\ of\ public\ facility \\ & \quad + welfare\ of\ insurance\ company - government\ transfer \end{aligned} \quad \textbf{(2. 49)}$$

The welfare of patient in the morning comes from the patient utility by visiting public and private facility and patient has insurance coverage that will relieve parts of treatment fee. The insurance component attaches to price variables.

$$\begin{aligned} & welfare\ of\ patient\ in\ the\ morning \\ & \quad = \int_0^{x_1^{am}} (y + \widetilde{q_1} - s\widetilde{p_1} - tx)dx \\ & \quad + \int_{x_1^{am}}^1 (y + {q_2}^{NI} - s{p_2}^{NI} - t(1-x))dx \end{aligned} \quad \textbf{(2. 50)}$$

The welfare of patient in the afternoon is a utility of patient by visiting private facility only with additional insurance component in the function.

$$\begin{aligned} & welfare\ of\ patient\ in\ the\ afternoon \\ & \quad = \int_0^1 (y + {q_2}^{NI} - s{p_2}^{NI} - t(1-x))dx \end{aligned} \quad \textbf{(2. 51)}$$

The welfare of private facility is a profit function of private facility that includes demand in the morning and in the afternoon as this facility opens in both opening hours.

$$welfare\ of\ private\ facility = \int_{x_1^{am}}^{1} D_2^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})({p_2}^{NI} - c_2)dx + \int_0^1 1.\,({p_2}^{NI} - c_2)dx - \varphi_2 \frac{{q_2}^{NI^2}}{2} \qquad \textbf{(2. 52)}$$

The welfare of public provider is the welfare of public facility when it is open in the morning.

$$welfare\ of\ public\ facility = \int_0^{x_{pub}} D_1^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2} \qquad \textbf{(2. 53)}$$

The related variables appear in welfare function can be summarized as follows, the y is patient's income, the s is the insurance component, the $\widetilde{p_1}$ and $\widetilde{q_1}$ are price and quality in public facility. The price and quality in private facility are ${p_2}^{NI}$ and ${q_2}^{NI}$. The cost components are travel cost (t), cost of treatment (c_2), and cost of quality treatment (φ_2).

The insurance company in our construction is the third party that will pay the part of insurance scheme, in the amount of $(1 - s)$ component that attach at price variable. The company will pay the part of treatment fee to facility. We simplify the case by putting the assumption that the government subsidized the insurance, $(1 - s)$ of all patients who demand health care. This assumption is a quite strong but it is not imaginary one. A government subsidy usually appears in developing country health system. The limited budget is made it impossible to provide free health care for all citizens. In consequence, the government will pay insurance premium for a certain group of people in the country, usually people from the low income level. In our case, the welfare of insurance company is set to break-even because the amount of payment paid by government to insurance company is equal with the amount of payment from insurance company to health care provider.

$$\begin{aligned} welfare\ of\ insurance\ company \\ = \Bigg(\int_0^{x_1^{am}} D_1^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\ (1-s)\widetilde{p_1} \\ + \int_{x_1^{am}}^1 D_2^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\ (1-s){p_2}^{NI} \\ + \int_0^1 D_2^{pm}({p_2}^{NI}, {q_2}^{NI})\ (1-s){p_2}^{NI} \Bigg) \\ - \Bigg(\int_0^{x_1^{am}} D_1^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\ (1-s)\widetilde{p_1} \\ + \int_{x_1^{am}}^1 D_2^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\ (1-s){p_2}^{NI} \\ + \int_0^1 D_2^{pm}({p_2}^{NI}, {q_2}^{NI})\ (1-s){p_2}^{NI} \Bigg) = 0 \end{aligned} \quad \textbf{(2.54)}$$

The government transfer, in this NI regime only consists of government transfer to the insurance company. We should go back to our decision stages that we do not include the government behavior in financing the health care system. We simplify the mechanism by making government pays the insurance part without further analysis on how government raising the funds that usually in the form of tax. The government is assumed to have sufficient budget in providing the insurance subsidy for the entire demand of health care. In principal, the government transfer is a part of the cost that will reduce the total welfare of the system.

$$
\begin{aligned}
&government\ transfer \\
&\qquad = \int_0^{x_1^{am}} D_1^{am}(p_2, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\,(1-s)\widetilde{p_1} \\
&\qquad + \int_{x_1^{am}}^1 D_2^{am}(p_2, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\,(1-s){p_2}^{NI} \\
&\qquad + \int_0^1 D_2^{pm}(p_2, {q_2}^{NI})\,(1-s){p_2}^{NI}
\end{aligned}
\qquad \textbf{(2. 55)}
$$

The total welfare of no dual practice- with insurance is,

$$total\ welfare(NI)$$

$$= \int_0^{x_1^{am}} (y + \widetilde{q_1} - s\widetilde{p_1} - tx)dx$$

$$+ \int_{x_1^{am}}^1 (y + {q_2}^{NI} - s{p_2}^{NI} - t(1-x))dx$$

$$+ \int_0^1 (y + {q_2}^{NI} - s{p_2}^{NI} - t(1-x))dx$$

$$+ \int_{x_1^{am}}^1 D_2^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})({p_2}^{NI} - c_2)dx$$

$$+ \int_0^1 1.({p_2}^{NI} - c_2)dx - \varphi_2 \frac{{q_2}^{NI^2}}{2}$$

$$+ \int_0^{x_1^{am}} D_1^{am}({p_2}^{NI}, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2}$$

$$- \left(\int_0^{x_1^{am}} D_1^{am}(p_2, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\,(1-s)\widetilde{p_1} \right.$$

$$+ \int_{x_1^{am}}^1 D_2^{am}(p_2, \widetilde{p_1}, {q_2}^{NI}, \widetilde{q_1})\,(1-s){p_2}^{NI}$$

$$\left. + \int_0^1 D_2^{pm}(p_2, {q_2}^{NI})\,(1-s){p_2}^{NI} \right) \qquad \textbf{(2. 56)}$$

2.5.3 The long run welfare effect of dual practice-no insurance

The welfare function of dual practice without insurance (DN) also consists of six elements. The welfare function of the patient in the morning is the utility function of the patient from visiting public and private facility. This is similar to the previous conditions of NN regime, as appears in 2.42 but using DN price and quality equilibrium.

$$Welfare\ of\ patient\ in\ the\ morning$$

$$= \int_0^{x_1^{am}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx$$

$$+ \int_{x_1^{am}}^1 (y + q_2{}^{DN} - p_2{}^{DN} - t(1-x))dx \qquad \textbf{(2. 57)}$$

In the existence of the dual practice, the public physician provides service in the dual practice facility. The welfare of patient in the afternoon then comes from the patient visiting dual practice facility and private facility. This part is the main difference with the two previous welfare functions of no dual practice with and without insurance (NN and NI).

$$welfare\ of\ patient\ in\ the\ afternoon$$

$$= \int_0^{x_1^{pm}} (y + q_1{}^{DN} - p_1{}^{DN} - tx)dx$$

$$+ \int_{x_1^{pm}}^1 (y + q_2{}^{DN} - p_2{}^{DN} - t(1-x))dx \qquad \textbf{(2. 58)}$$

In the regime of dual practice without insurance, the private facility welfare is the additional form of profit function of the dual practice facility in the afternoon and private facility in the morning and afternoon.

$$welfare\ of\ private\ facility = \left(\int_{x_1^{am}}^{1} D_2^{am}({p_2}^{DN}, \widetilde{p_1}, {q_2}^{DN}, \widetilde{q_1})({p_2}^{DN} - c_2)dx + \int_{x_1^{pm}}^{1} D_2^{pm}({p_2}^{DN}, {p_1}^{DN}, {q_2}^{DN}, {q_1}^{DN})({p_2}^{DN} - c_2)dx - \varphi_2 \frac{{q_2^{DN}}^2}{2} \right) + \left(\int_0^{x_1^{pm}} D_1^{pm}({p_2}^{DN}, {p_1}^{DN}, {q_2}^{DN}, {q_1}^{DN})({p_1}^{DN} - c_1)dx - \varphi_1 \frac{{q_1^{DN}}^2}{2} \right) \quad \textbf{(2. 59)}$$

The welfare of public provider is the profit function of the public facility and similar to the situation without dual practice (NN):

$$welfare\ of\ public\ facility = \int_0^{x_1^{am}} D_1^{am}({p_2}^{DN}, \widetilde{p_1}, {q_2}^{DN}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2} \quad \textbf{(2. 60)}$$

The patient's income is *y*, while price and quality in public provider are $\widetilde{p_1}$ and $\widetilde{q_1}$. The price and quality in private facility are ${p_2}^{DN}$ and ${q_2}^{DN}$. In the regime where dual practice exists in the system, the price and quality component of dual practice facility are ${p_1}^{DN}$ and ${q_1}^{DN}$. The cost components are following the previous regime that consist of travel cost (*t*), cost of treatment in private facility (c_2), and cost of quality treatment in private facility (φ_2). The cost component of c_1 in this case represents cost of treatment in public facility and dual practice facility. The $\varphi_1$describes the quality cost in public provider and dual practice facility. The welfare of insurance company is null because there is no insurance in the system. The total welfare function can be written as:

$$
\begin{aligned}
&total\ welfare \\
&= \int_0^{x_1^{am}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx \\
&+ \int_{x_1^{am}}^1 (y + q_2{}^{DN} - p_2{}^{DN} - t(1-x))dx \\
&+ \int_0^{x_1^{pm}} (y + q_1{}^{DN} - p_1{}^{DN} - tx)dx \\
&+ \int_{x_1^{pm}}^1 (y + q_2{}^{DN} - p_2{}^{DN} - t(1-x))dx \\
&+ \Bigg(\int_{x_1^{am}}^1 D_2^{am}(p_2{}^{DN}, \widetilde{p_1}, q_2{}^{DN}, \widetilde{q_1})(p_2{}^{DN} - c_2)dx \\
&+ \int_{x_1^{pm}}^1 D_2^{pm}(p_2{}^{DN}, p_1{}^{DN}, q_2{}^{DN}, q_1{}^{DN})(p_2{}^{DN} - c_2)dx \\
&- \varphi_2 \frac{{q_2{}^{DN}}^2}{2}\Bigg) \\
&+ \Bigg(\int_0^{x_1^{pm}} D_1^{pm}(p_2{}^{DN}, p_1{}^{DN}, q_2{}^{DN}, q_1{}^{DN})(p_1{}^{DN} \\
&- c_1)dx - \varphi_1 \frac{{q_1{}^{DN}}^2}{2}\Bigg) \\
&+ \Bigg(\int_0^{x_1^{am}} D_1^{am}(p_2{}^{DN}, \widetilde{p_1}, q_2{}^{DN}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx \\
&- \varphi_1 \frac{\widetilde{q_1}^2}{2}\Bigg)
\end{aligned}
\tag{2. 61}
$$

2.5.4 The long run welfare effect of dual practice- insurance

The last case is the case of dual practice with insurance (DI) which also consists of six elements. The first one is the welfare function of the patient in the morning which is the utility function of the patient from visiting public and private facility with the involvement of insurance in the function.

$$Welfare\ of\ patient\ in\ the\ morning$$
$$= \int_0^{x_1^{am}} (y + \widetilde{q_1} - s\widetilde{p}_1 - tx)dx$$
$$+ \int_{x_1^{am}}^1 (y + {q_2}^{DI} - s{p_2}^{DI} - t(1 - x))dx \qquad \textbf{(2. 62)}$$

The welfare of patient in the afternoon covers the patient's welfare from dual practice facility and private facility.

$$welfare\ of\ patient\ in\ the\ afternoon$$
$$= \int_0^{x_1^{pm}} (y + {q_1}^{DI} - s{p_1}^{DI} - tx)dx$$
$$+ \int_{x_1^{pm}}^1 (y + {q_2}^{DI} - s{p_2}^{DI} - t(1 - x))dx \qquad \textbf{(2. 63)}$$

In dual practice-with insurance situation private facility in the afternoon consists of private facility and dual practice. Hence the private facility welfare is the additional function from profit of private facility in the morning, private facility in the afternoon, and the dual practice facility in the afternoon. The dual practice-with insurance regime involves the insurance component in demand of health care.

$$welfare\ of private\ facility = \left(\int_{x_1^{am}}^{1} D_1^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})({p_2}^{DI} - c_2)dx + \int_{x_1^{pm}}^{1} D_2^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})(p_2 - c_2)dx - \varphi_2 \frac{{q_2}^{DI^2}}{2} \right) + \left(\int_{0}^{x_1^{pm}} D_1^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})(p_1 - c_1)dx - \varphi_1 \frac{{q_1}^{DI^2}}{2} \right) \quad \textbf{(2. 64)}$$

The welfare of public facility is the profit function of the public facility, similar with the function of no dual practice-with insurance (NI):

$$welfare\ of\ public\ facility = \int_{0}^{x_1^{am}} D_1^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2} \quad \textbf{(2. 65)}$$

The variables in the welfare function of dual practice-with insurance regime (DI) are the variable of insurance (*s*), the price and quality in public facility ($\widetilde{p_1}, \widetilde{q_1}$), the price and quality in private facility (${p_2}^{DI}, {q_2}^{DI}$), and the price and quality in dual practice facility (${p_1}^{DI}, {q_1}^{DI}$). The remaining variables are the travel cost (*t*), the cost of treatment (c_1, c_2), and cost of quality (φ_1, φ_2). The subscript of 1 in cost component represents cost component in public and dual practice facility. The subscript of 2 represents cost components in private provider.

We set the revenue and cost in the insurance company is equal. The company receives insurance transfer from the government, and the company will pay the same amount to the health care providers so that the remaining fund in insurance company is zero.

$$
\begin{aligned}
&welfare\ of\ insurance\ company \\
&= \Bigg(\int_0^{x_1^{am}} D_1^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})\,(1-s)\widetilde{p_1} \\
&+ \int_{x_1^{am}}^{1} D_2^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})\,(1-s){p_2}^{DI} \\
&+ \int_0^{x_1^{pm}} D_1^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})\,(1-s){p_1}^{DI} \\
&+ \int_{x_1^{pm}}^{1} D_2^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})\,(1-s){p_2}^{DI}\Bigg) \\
&- \Bigg(\int_0^{x_1^{am}} D_1^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})\,(1-s)\widetilde{p_1} \\
&+ \int_{x_1^{am}}^{1} D_2^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})\,(1-s){p_2}^{DI} \\
&+ \int_0^{x_1^{pm}} D_1^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})\,(1-s){p_1}^{DI} \\
&+ \int_{x_1^{pm}}^{1} D_2^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})\,(1-s){p_2}^{DI}\Bigg) = 0 \qquad \textbf{(2. 66)}
\end{aligned}
$$

The government transfer is a part of treatment fee transferred to the insurance company.

$$
\begin{aligned}
&\mathit{government\ transfer}\\
&\qquad = \int_0^{x_1^{am}} D_1^{am}(p_2{}^{DI},\widetilde{p_1},q_2{}^{DI},\widetilde{q_1})\,(1-s)\widetilde{p_1}\\
&\qquad + \int_{x_1^{am}}^{1} D_2^{am}(p_2{}^{DI},\widetilde{p_1},q_2{}^{DI},\widetilde{q_1})\,(1-s)p_2{}^{DI}\\
&\qquad + \int_0^{x_1^{pm}} D_1^{pm}(p_2{}^{DI},p_1,q_2{}^{DI},q_1{}^{DI})\,(1-s)p_1{}^{DI}\\
&\qquad + \int_{x_1^{pm}}^{1} D_2^{pm}(p_2{}^{DI},p_1{}^{DI},q_2{}^{DI},q_1{}^{DI})\,(1-s)p_2{}^{DI}
\end{aligned}
\tag{2. 67}
$$

The total welfare function in the dual practice and insurance regime can be written as:

$$
\begin{aligned}
&total\ welfare(DI)\\
&= \int_0^{x_1^{am}} (y + \widetilde{q_1} - s\widetilde{p}_1 - tx)dx\\
&+ \int_{x_1^{am}}^{1} \big(y + {q_2}^{DI} - s{p_2}^{DI} - t(1-x)\big)dx\\
&+ \int_0^{x_1^{pm}} (y + {q_1}^{DI} - s{p_1}^{DI} - tx)dx\\
&+ \int_{x_1^{pm}}^{1} (y + {q_2}^{DI} - s{p_2}^{DI} - t(1-x))dx\\
&+ \Bigg(\int_{x_1^{am}}^{1} D_1^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})({p_2}^{DI} - c_2)dx\\
&+ \int_{x_1^{pm}}^{1} D_2^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})(p_2 - c_2)dx\\
&- \varphi_2 \frac{{{q_2}^{DI}}^2}{2}\Bigg)\\
&+ \Bigg(\int_0^{x_1^{pm}} D_1^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})(p_1 - c_1)dx\\
&- \varphi_1 \frac{{{q_1}^{DI}}^2}{2}\Bigg)\\
&+ \Bigg(\int_0^{x_1^{am}} D_1^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2}\Bigg)\\
&- \Bigg(\int_0^{x_1^{am}} D_1^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})\,(1-s)\widetilde{p_1}\\
&+ \int_{x_1^{am}}^{1} D_2^{am}({p_2}^{DI}, \widetilde{p_1}, {q_2}^{DI}, \widetilde{q_1})\,(1-s){p_2}^{DI}\\
&+ \int_0^{x_1^{pm}} D_1^{pm}({p_2}^{DI}, p_1, {q_2}^{DI}, {q_1}^{DI})\,(1-s){p_1}^{DI}\\
&+ \int_{x_1^{pm}}^{1} D_2^{pm}({p_2}^{DI}, {p_1}^{DI}, {q_2}^{DI}, {q_1}^{DI})\,(1-s){p_2}^{DI}\Bigg)
\end{aligned}
\qquad \textbf{(2. 68)}
$$

2.5.5 Important note regarding welfare effects in long run

In this sub chapter, we discuss the essential findings regarding long run welfare functions in different regulations of dual practice and insurance that we described in 2.5.1 to 2.5.4. We analyze the general effect of dual practice and insurance in total welfare.

Proposition 12: *Dual practice effect might be positive or negative to total welfare depending on parameter values.*

The complete proof is available in Appendix 2.C.4. We will measure the effect of dual practice using variable d by first calculating the new equilibrium price for private facility (p_2^{DP}) and dual practice facility (p_1^{DP}) when dual practice is allowed in the system. Assume that now we have variable of d that represents part of population who able to access dual practice physician, while the $(1-d)$ is part of population that is unable to access dual practice physician. The profit function of private facility (${\pi_{pv}}^{DP}$) consists of profit in the morning and afternoon demand. The dual practice effect, variable of d will appear in the afternoon profit function because dual practice only appears in the afternoon demand.

$$\begin{aligned}{\pi_{pv}}^{DP} = D_2^{am}({p_2}^{DP}, \widetilde{p_1}, {q_2}^{DP}, \widetilde{q_1})(p_2^{DP} - c_2) \\ + d.D_2^{pm}(p_2^{DP}, {q_2}^{DP})(p_2^{DP} - c_2) + (1 \\ - d)D_2^{pm}(p_2^{DP}, {q_2}^{DP})(p_2^{DP} - c_2) - \varphi_2 \frac{{{q_2}^{DP}}^2}{2}\end{aligned}$$

$$\pi_{pv}{}^{DP} = D_2^{am}(p_2{}^{DP},\widetilde{p_1},q_2{}^{DP},\widetilde{q_1})(p_2^{DP}-c_2) + d.D_2^{pm}(p_2^{DP},q_2{}^{DP})(p_2^{DP}-c_2) + (1 - d)D_2^{pm}(p_2^{DP},q_2{}^{DP})(p_2^{DP}-c_2) - \varphi_2\frac{{q_2{}^{DP}}^2}{2}$$

$$\pi_{pv}{}^{DP} = x_2{}^{am}(p_2^{DP}-c_2) + d.x_2{}^{pm}.(p_2^{DP}-c_2) + (1 - d)x_2{}^{pm}.(p_2^{DP}-c_2) - \varphi_2\frac{{q_2{}^{DP}}^2}{2}$$

$$\pi_{pv}{}^{DP} = \frac{t-\widetilde{q_1}+\widetilde{p_1}+q_2{}^{DP}-p_2^{DP}}{2t}(p_2^{DP}-c_2) + d.\frac{t-q_1{}^{DP}+p_1{}^{DP}+q_2{}^{DP}-p_2{}^{DP}}{2t}.(p_2^{DP}-c_2) + (1-d).\frac{t-q_1{}^{DP}+p_1{}^{DP}+q_2{}^{DP}-p_2{}^{DP}}{2t}.(p_2^{DP} - c_2) - \varphi_2\frac{{q_2{}^{DP}}^2}{2} \quad \textbf{(2. 69)}$$

After setting $\frac{\partial\pi_{pv}{}^{Dp}}{\partial p_2{}^{DP}} = 0, \frac{\partial\pi_{pv}{}^{DP}}{\partial q_2{}^{DP}} = 0, \frac{\partial\pi_{pv(DP)}{}^{DP}}{\partial p_1{}^{DP}} = 0, \frac{\partial\pi_{pv(DP)}{}^{DP}}{\partial q_1{}^{DP}} = 0$, we get new equilibrium price in private facility,

$$p_2^{DP} = \frac{(2x_2t^2-\widetilde{q_1}x_2t+\widetilde{p_1}x_2t-2c_2+2c_2x_2t)(2x_1t)(4x_1t-1)(2x_2t)+(c_1x_2t)(4x_1t-1)(2x_2t)}{(4x_2t-3+d)(2x_1t)(4x_1t-1)(2x_2t)-(2x_2t)(2x_1t-1)(4x_1tx_2t-3+d)} + \frac{(x_2t)(2x_1t-1)(2x_1t^2-c_1+2c_1x_1t)(2x_2t)+(x_2t)(2x_1t-1)(2c_2)}{(4x_2t-3+d)(2x_1t)(4x_1t-1)(2x_2t)-(2x_2t)(2x_1t-1)(4x_1tx_2t-3+d)} \quad \textbf{(2. 70)}$$

The new equilibrium for price in dual practice facility is,

$$p_1^{DP} = \frac{(2x_1t^2 - c_1 + 2c_1x_1t)(2x_1t)(4x_2t - 3 + d)(2x_2t) + (2c_2)(2x_1t)(4x_2t - 3 + d)}{(4x_2t - 3 + d)(2x_1t)(4x_1t - 1)(2x_2t) - (2x_2t)(2x_1t - 1)(4x_1tx_2t - 3 + d)}$$

$$+ \frac{(4x_1tx_2t - 3 + d)(2x_1t)(2x_2t^2 - \widetilde{q_1}x_2t + \widetilde{p_1}x_2t - 2c_2 + 2c_2x_2t) + (4x_1tx_2t - 3 + d)(c_1x_2t)}{(4x_2t - 3 + d)(2x_1t)(4x_1t - 1)(2x_2t) - (2x_2t)(2x_1t - 1)(4x_1tx_2t - 3 + d)}$$

(2. 71)

Next step is to compose total welfare (TW^{DP}) that contains dual practice effect of d. The total welfare consists of welfare from three agents, consumer, private facility, and public facility.

$$TW^{consumer} = \int_0^{x_1^{am}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx$$

$$+ \int_{x_1^{am}}^1 (y + q_2{}^{DP} - p_2{}^{DP} - t(1-x))dx$$

$$+ \int_0^{x_1^{pm}} (y + q_1{}^{DP} - p_1{}^{DP} - tx)dx$$

$$+ \int_{x_1^{pm}}^1 (y + q_2{}^{DP} - p_2{}^{DN} - t(1-x))dx$$

(2. 72)

$$TW^{private} = \left(\int_{x_1^{am}}^{1} (p_2{}^{DP}, \widetilde{p_1}, q_2{}^{DP}, \widetilde{q_1})(p_2{}^{DP} - c_2)dx + \int_{x_1^{pm}}^{1} (p_2{}^{DP}, p_1{}^{DP}, q_2{}^{DP}, q_1{}^{DP})(p_2{}^{DP} - c_2)dx - \varphi_2 \frac{q_2{}^{DP^2}}{2}\right) + \left(\int_{0}^{x_1^{pm}} (p_2{}^{DP}, p_1{}^{DP}, q_2{}^{DP}, q_1{}^{DP})(p_1{}^{DP} - c_1)dx - \varphi_1 \frac{q_1{}^{DP^2}}{2}\right) \quad \textbf{(2. 73)}$$

$$TW^{public} = \int_{0}^{x_1^{am}} (p_2{}^{DP}, \widetilde{p_1}, q_2{}^{DP}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2} \quad \textbf{(2. 74)}$$

For each agent's welfare we analyze the sign of $\frac{\partial TW}{\partial d}$. We analyze $\frac{\partial TW^{consumer}}{\partial d}, \frac{\partial TW^{private}}{\partial d}, \frac{\partial TW^{public}}{\partial d}$ when $d = 0$. We summarize the sign for each part of total welfare in Table 2.2.

Table 2. 2. Effect of dual practice to total welfare by component

$\frac{\partial TW}{\partial d}$		
$\frac{\partial TW^{consumer}}{\partial d}$	$\frac{\partial TW^{private}}{\partial d}$	$\frac{\partial TW^{public}}{\partial d}$
+	-	+/-

The increasing percentage of dual practice in the system will increase the consumer welfare. The explanation comes from the more dual practice means more physicians and lower price. This benefits the consumer. The increasing dual practice involvement in the system will bring negative effect to private facility welfare. The facility suffers because they offers lower price due to dual practice, which now competes with it. The ambiguity appears in public facility welfare. The facility might get positive or negative effect with the increasing dual practice. The ambiguous sign in total welfare comes from this component. Public facility gets less benefit from indirect relation with dual practice facility. It gets less benefit if private facility offer lower price (due to competition with dual practice in the afternoon), hence in the morning, most people will shift to private facility. Public facility still gets benefit if the demand shift to private facility due to lower price in the morning not caused severe loss and it is covered from the price margin. The sign for total welfare that is a summation function of welfare of consumer, welfare of private facility, and welfare of public facility, $\frac{\partial TW}{\partial d}$ when $d = 0$ can be positive or negative. The results suggest that increasing dual practice involvement in the system (we can associate as increasing population percentage who can get dual practice), may lead to increasing or decreasing of total welfare.

The impact of dual practice to total welfare is closely related with the changing demand. In the situation when patient in the morning mostly visit private facility so that demand in public facility is very low, while in the afternoon most people visit dual practice facility and only small portion goes to private facility. If the loss of public facility in the morning and private facility in the afternoon can be compensated from high demand from private facility in the morning and dual practice in the afternoon, then dual practice effect leads to positive impact to total welfare.

Proposition 13: *Increasing insurance coverage from no insurance state in general might increase or decrease the total welfare because of market interaction between public facility and private facility.*

We analyze the effect of insurance to total welfare by first arranging total welfare function which allowing insurance presents in the system and ignoring dual practice. We decompose the total welfare function based on consumer welfare, private facility welfare, public welfare, and government transfer.

$$\begin{aligned} &total\ welfare(TW^{NI}) \\ &\quad = welfare\ of\ consumer \\ &\quad + welfare\ of\ private\ facility \\ &\quad + welfare\ of\ public\ facility \\ &\quad + government\ transfer \end{aligned} \quad \textbf{(2. 75)}$$

$$\begin{aligned} &TW^{NI\ consumer} \\ &\quad = \int_0^{x_1^{am}} (y + \widetilde{q_1} - s\widetilde{p_1} - tx)dx \\ &\quad + \int_{x_1^{am}}^1 \big(y + {q_2}^{NI} - s{p_2}^{NI} - t(1-x)\big)dx \\ &\quad + \int_0^1 \big(y + {q_2}^{NI} - s{p_2}^{NI} - t(1-x)\big)dx \end{aligned} \quad \textbf{(2. 76)}$$

$$TW^{NI\,private} = \int_{x_1^{am}}^{1} (sp_2{}^{NI} - c_2)dx$$

$$+ \int_0^1 1.(sp_2{}^{NI} - c_2)dx - \varphi_2 \frac{q_2{}^{NI^2}}{2} \quad \textbf{(2. 77)}$$

$$TW^{NI\,private} = (sp_2{}^{NI} - c_2) - \frac{t - s\widetilde{p_1} + p_2{}^{NI}}{2t}(sp_2{}^{NI} - c_2)$$

$$+ (sp_2{}^{NI} - c_2) - \varphi_2 \frac{q_2{}^{NI^2}}{2} \quad \textbf{(2. 78)}$$

$$TW^{NI\,government\,trasnfer}$$

$$= \int_0^{x_1^{am}} (1-s)\widetilde{p_1} + \int_{x_1^{am}}^{1} (1-s)p_2{}^{NI}$$

$$+ \int_0^1 (1-s)p_2{}^{NI} \quad \textbf{(2. 79)}$$

We assume that in this point, there is no quality choice in public facility and private facility and it is assumed equal qualities to make the analysis simpler and more intuitive. Hence $\widetilde{q_1} = q_2{}^{NI}$. We have $x_1^{am} = \frac{t - s\widetilde{p_1} + p_2{}^{NI}}{2t}$. The last part of the total welfare function, is the part of the price that covered by insurance. When we recall back our total welfare in sub chapter 2.5.2, the part of the price that is covered by insurance will be paid by insurance company, while the insurance company will get the same amount from the government. In this case, the government will pay the deficit between price paid by the individual and amount of money received by public or private facility. In sub chapter 2.5.2 we call this term as government transfer. The complete proof is available in the Appendix 2.C.3.

From equation 2.24, we have equilibrium price for private facility in no dual practice with insurance situation as ${p_2}^{NI} = \frac{3t-\widetilde{q_1}+s\widetilde{p_1}+(s-\frac{1}{2\varphi_2 t})c_2}{2\left(s-\frac{1}{4\varphi_2 t}\right)}$. We use this values to replace the ${p_2}^{NI}$ in $total\ welfare(TW^{NI})$ function. Then we calculate the $\frac{\partial TW^{NI}}{\partial s}$ when $s = 1$ for each agent in total welfare function. The consumer welfare, private facility welfare, and governed transfer give ambiguous sign. Public facility is the only agent which always gets benefit with the introduction of insurance. Consumer, private facility, and government transfer might have benefit as well as suffers from loss when insurance is present in the system.

Table 2. 3 Effect of insurance to total welfare by components

$\frac{\partial TW}{\partial s}$			
Consumer	Private facility	Public facility	Government transfer
+/-	+/-	+	+/-

The result for total welfare is $\frac{\partial TW^{NI}}{\partial s} <> 0\ when\ s = 1$. Remember that s is variable that represents percentage of price that paid by patient. The insurance component is $(1 - s)$. The introduction of insurance to the system might bring positive or negative effect to total welfare. Consumers benefits from insurance because although the price of treatment is higher than price without insurance, they do not pay at full price. Private facility also enjoys the insurance because insurance makes price higher and all individuals will come to private facility in the afternoon. But the higher the insurance percentage, the government transfer is also getting higher. The loss from paying the government transfer is higher than the consumer benefit and private facility welfare; hence the total welfare is lower with the increasing of insurance coverage.

We also provide the results using simulation to see how each components of social welfare are affected by variables in the system and the welfare comparison among four regimes: no dual practice-no insurance (NN), no dual practice-with insurance (NI), dual practice-no insurance (DN), and dual practice-insurance (DI). The welfare effect in the long run uses the adjusted price and adjusted quality after reaching the equilibrium state. We assume that in the long period, the price and quality in private facility will have enough time to adapt to the price and quality in public facility that set by government. The comparison is especially needed to provide a judgement on the dual practice and insurance policy.

The simulation uses sets of values and must fulfill with several requirements when finding the price and quality equilibrium. Basically the requirements are that the cost and prices components should be more than zero. The cost of quality in the public and private facilities are larger than zero, $\varphi_1 > 0,\ \varphi_2 > 0$. The price and quality in public facility are larger than zero, $\widetilde{q_1} > 0, \widetilde{p_1} \geq 0$, although for public facility, we allow the public to have zero price to represent a particular situation where public facility is served in zero price as a government's commitment to provide public goods. The general setting of price and quality that larger than zero is a guarantee for the facility to be functioned properly in serving health treatment. The same condition applies for the equilibrium price and quality in private facility, $q_2 > 0, p_2 > 0$. The price has to be greater than zero because we assume that private facility needs a non-zero price to gain profit and maintain the sustainability of practice. The cost of treatment in public and private facilities is greater than zero because it would be impossible to produce treatment at zero or negative cost, $c_1 > 0, c_2 > 0$. The other components such as travel cost and income also should be larger than zero, $t > 0, y > 0$. Travel cost describes patient's consideration to health care facility that also influenced by other factor than price. These two components also represent patient's characteristics.

In order to guarantee the result of total welfare, we limit the result where all welfare components are non-negative and the demands are between zero and one. The positive welfare such as welfare in health care facility illustrates that the facility can properly function for providing health care in the system. To illustrate the welfare components with the price of public facility set by government, the next illustration uses these particular values of: $\varphi_1 = 2$; $\varphi_2 = 2; t = 40$; $\widetilde{q_1} = 0.1$; $c_1 = 5$; $c_2 = 5; y = 200, (1 - s) = 0.4; 0 \leq \widetilde{p_1} \leq 100$. The public price interval that met the conditions under NN regime is $45 \leq \widetilde{p_1} \leq 100$. The welfare of patient comes from patient's utility function, which involves individual income, the price of treatment, quality of treatment, travel cost and distance to the facility. By keeping other variables are constant and increasing only the price in public facility, the welfare of patient in the morning and afternoon are decreasing along with the increasing of the public price. Patients have less welfare from paying higher price in both facilities when public facility increases its price while private facility also follows to increase up the price.

The Figure 2.D.1 in Appendix 2D shows two welfare functions of patient in the morning and afternoon with the relationship of price in public under regime without dual practice and insurance in the system. The price equilibrium shows that when the price in public is increasing, the price in private is also increasing. The demand for public health care goes down when the price in public is increasing. In the morning, the patient can choose between public facility and private provider. The patient's loss from the increasing price in one of the facility can be covered with the adjustment to choose another provider from the patient perspective, in this case patient can go to private facility. The demand for the private sector is increasing along with the decreasing demand for public care. The alternative between public and private functions as shifting demand between two providers but the increasing price in general gives decreasing welfare for patient. In the afternoon, patient can only visit the private facility; the rising price in private sector is a consequence of the increasing public price in the long run. The increasing price is a loss from a patient perspective because he has to pay a higher price and reduce his net income, but still, the private sector is the only place the patient can get the treatment in the afternoon.

The provider's welfare comes from public and private facility profit function. It mainly consists of demand, price, and cost. The price, in the long run, uses the price and quality in an equilibrium state. The Figure 2.D.2 in the Appendix 2D shows health care facility welfare function related to the price in public in the regime without dual practice and insurance. The welfare of health care facility is in line with the increasing price both in public and in private sector. We should note that the private price is increasing as the public price is also increasing. The increasing price in public is followed by the drop in demand for the public facility. The decreasing demand is still covered with profit margin from the increasing price in public facility; hence the welfare in public is still increasing.

In private facility, the demand for private is going up with the increasing of the price in public facility. This increasing demand adds to the increasing price in private accumulates the increasing of welfare in private sector. The higher price in private leads to higher profit for a private facility, hence the welfare level is high in this situation.

The different trend of facility welfare can be appeared in different situation, for example in the regime with dual practice-no insurance. The increasing of public price will be followed by the increasing of the price in private facility. Patients might still visit public facility and it has increasing profit from the increasing demand of public facility at the beginning. After some time, patients could change their choice to visit private facility, and the number of people visiting public facility might become lower. The public facility now has profit loss due to this demand shift. On the other hand, some patients might keep visiting private facility and would pay the increasing price because they realize that they will get more treatment in term of quality. The private facility has the increasing welfare because it still gets profit from the increasing price and relatively escalating demand for private health care. It is illustrated in the Figure 2.D.3 in Appendix 2D.

Remark 3: *The insurance coverage in the system gives more welfare for patient in the long run compared to the no insurance situation.*

We compare the patient welfare between two regimes to justify the role of insurance in the welfare functions: no dual practice-no insurance, and no dual practice-with insurance. We should go back to our previous finding on the relationship between the level of insurance and the price in private facility. The higher level of insurance makes private facility sets the higher price. Patients might shift demand from public facility to private facility in the morning, so that the demand of public facility will decrease while demand of private facility will increase. In the afternoon, people only could visit private facility so there is no shift demand in the afternoon.

The existence of the insurance will lighten part of treatment fee although in our case the price effect seems more dominant so that the patient's welfare will decrease along with the increasing price. But between with and without insurance situation, patients benefit more from having insurance so that the welfare of patient under insurance is higher than without insurance. The price of private facility might be higher but patients with insurance have more protection and can afford the price. This can be translated that patients gain more in term of welfare. Patient without insurance will pay the whole part of treatment fee so the patient's welfare will be more sensitive to price. This is a loss from welfare point of view. The Figure 2.D.4 of Appendix 2D shows increasing price in public and welfare of patient in two regimes without dual practice, with and without insurance. The patient welfare in the morning with insurance is higher than patient welfare without insurance. The same thing also applies for the welfare of patient in the afternoon.

Remark 4: *The private facility gains higher profit when the insurance coverage exists in the system.*

The Figure 2.D.5 in the Appendix 2D shows the welfare of private facility between the initial cases of no dual practice-no insurance with the current case of no dual practice-with insurance. Under insurance regime, the private facility enjoys the higher price than without insurance regime. Although having higher price, the demand for private care is not disturbed because people can pay the treatment using insurance protection. The private facility gains more profit this means higher level of welfare.

Remark 5: *The higher percentage of insurance covers the treatment fee, the total welfare of no dual practice-with insurance regime will be lower compare to the base case of no dual practice-no insurance regime.*

The total welfare of no dual practice-with insurance regime shows the decreasing trend along with the percentage of insurance. In Figure 2.D.6 of the Appendix 2D, we compare the total welfare of the initial situation, no dual practice-no insurance, compares to no dual practice-with insurance with two different levels of insurance coverage. Having a relatively small percentage of insurance (1-s) makes the total welfare going down from the initial level where there is no insurance in the system. The higher percentage of insurance, the total welfare decreases more. From patient's perspective, the increasing insurance rate has increased the price of private sector. However, the increasing price does not reduce demand for private care as patients pay less of treatment fee. The more insured patient, the less sensitive those to the increasing price in private sector. The harm of insurance to welfare system is due to government subsidy for the patients. Under insurance regime, government has to transfer part of treatment fee to insurance company. The more insurance coverage means that the government has to provide more subsidies for the insurance. It will reduce the total welfare from our welfare function definition.

Remark 6: *In the long run, welfare of patient under dual practice regime is higher than nondual practice regime.*

Allowing dual practice in the system also means that private sector now divides into the private facility and dual practice facility. Patient in the afternoon chooses between those two facilities. The added facility is a new competitor as the private sector is not dominated by one player only. The private facility reduces its price hence it benefits patients because they pay less price than before. The Figure 2.D.7 of Appendix 2D shows the welfare of patient in the morning with dual practice-no insurance and without dual practice-no insurance compare with the price in public. The welfare of patient under dual practice has a higher level than no dual practice regime.

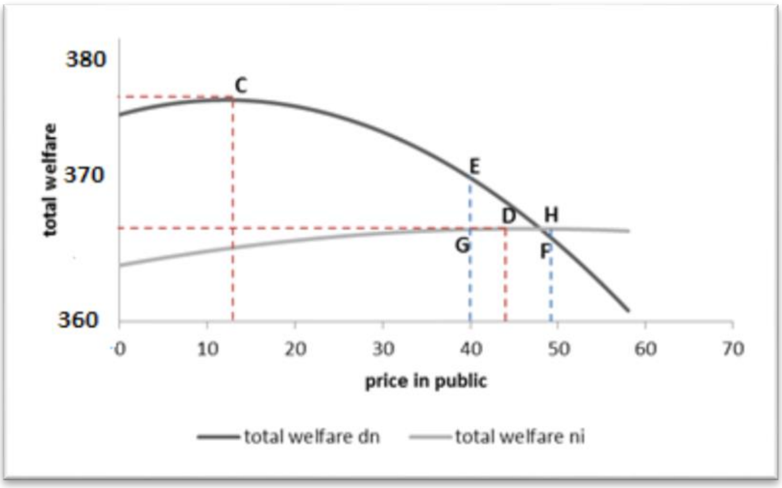
The Figure 2.D.8 in the Appendix 2D shows the welfare of patient in the afternoon at the initial case and the one after dual practice been introduced in the system. The patients view the existence of dual practice as the one that lowered the price of treatment fee and it means the increasing of welfare level.

Remark 7: *The profit of public and private facility in the long run under dual practice regime is lower than non-dual practice regime.*

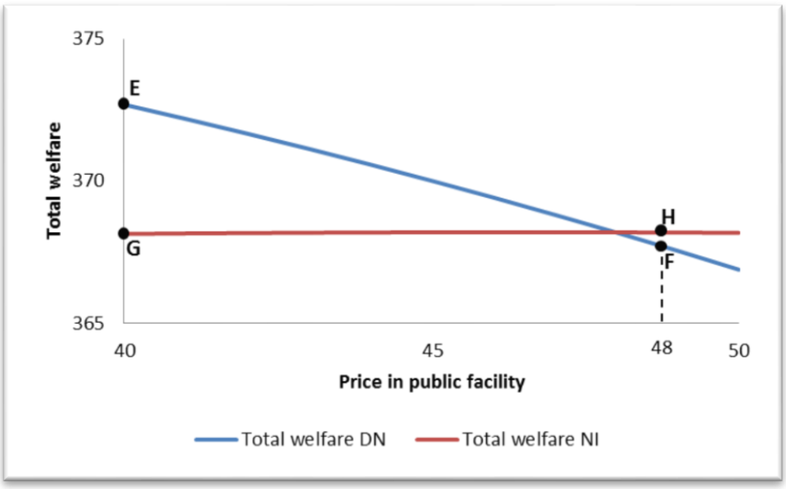
The increasing of public price makes the profit of public facility increases as well. In Figure 2.D.9 of the Appendix 2D, we show the comparison between the profit of public facility in the first regime (no dual practice-no insurance) with the dual practice-no insurance regime. The graph describes the moving of public facility profit after dual practice has been applied to the system. Allowing dual practice adds another competitor in the afternoon hours with the dual practice physician offering his service in the dual practice facility. The additional competitor reduces the price of private facility level. In the morning, when a patient chooses between public or private facility, the decreasing price shifts patient from the public to private, then the public demand decreases. Hence the profit level in dual practice-no insurance is lower than no dual practice-no insurance situation. The similar result occurs for the private facility as it appears in Figure 2.D.10 of the Appendix 2D. The private facility might gain profit from increasing demand because patients are shifting from public to private but the decreasing price gives more dominant effect to the reducing of total welfare. Besides that, the dual practice facility makes private facility no longer a sole choice in the afternoon. This means reducing demand of private facility so that the profit of private facility under dual practice-no insurance is lower than welfare of no dual practice-no insurance.

Remark 8: *In the long run, where we use the adjusted price of private facility and quality of private facility, introducing insurance or allowing dual practice in health care system shows that no regime dominates each other in term of total welfare and the result depends on the parameter values.*

To illustrate the comparison between the total welfare of long run from having dual practice only and insurance only, we focus on interior equilibrium solution using the parameters of, $\varphi_1 = \varphi_2 = 5$; $t = 15$; $\widetilde{q_1} = 0.1$; $c_1 = 2$; $c_2 = 15$; $s = 0.6$; $0 \leq \widetilde{p_1} \leq 60$. In general, by keeping other variables constant and the same interval of price in public, total welfare in dual practice-no insurance (DN) and no dual practice-with insurance (NI) have similar patterns along with the increasing values of price in public set by government. Total welfare first goes up then goes down after reaching a peak point. The difference lays on the increasing speed as the NI gives slower speed compares to DN. The total welfare of DN reaches peak point earlier than total welfare of NI. In the Figure 2.6A, the total welfare of DN reaches its maximum point at point C, then decreasing along with the increasing of price in public facility. The total welfare of NI reaches its maximum point at D, then it goes down in slower rate.



(A)



(B)

Figure 2. 7 Total welfare under dual practice-no insurance and no dual practice insurance

We put conditions to guarantee the result. Some of the conditions are: the demand is between zero and one, while the price, the quality and welfare components are larger than zero. Using the same variables and interval of price in public, the combination of variables that met the conditions are in between EF for the total welfare of DN and GH for the total welfare of NI, or $40 \leq \widetilde{p_1} \leq 48$. Please note that the points H and F almost coincide each other due to the slower rate of increasing total welfare NI compare to total welfare DN. The Figure 2.7B is the zoom out of the Figure 2.7A that highlights the points to describe the Figure 2.7A more clearly.

Comparing between two health care access policies whether having dual practice or increasing insurance coverage gives the highest total welfare means that we are comparing two welfare function between regime of dual practice-no insurance (DN) with the no dual practice-with insurance (NI). The detailed description of simulation result is provided in Table 2.4. The total welfare of DN is higher than total welfare of NI at the beginning of range values of $\widetilde{p_1}$ in Figure 2.7A, and we take example of two points of point E and point G that represent point where DN>NI. Under dual practice regime, most people in the morning visit private facility and the level of public demand is low, while the demand of private facility is high. The afternoon pattern shows that most patient visit dual practice facility instead of private facility. The loss from public sector due to the low level of demand is compensated from the welfare of private facility and dual practice facility. Hence the total welfare under dual practice regime is still high. On the other hand, under insurance regime, the demand of public facility is very high compares to the demand of private facility. Although all patients in the afternoon visit private facility, but in total welfare, the dual practice shows higher effect compares to insurance effect.

Table 2. 4 Parameter values on total welfare of dual practice and insurance in long run

Variables	DN>NI		DN<NI	
	E(DN)	G(NI)	F(DN)	H(NI)
φ_1	5			
φ_2	5			
c_1	2			
c_2	15			
t	15			
$\widetilde{q_1}$	0.1			
s	0.6			
y	200			
$\widetilde{p_1}$	40.00	40.00	48.00	48.00
Demand of public in the morning	0.20	0.99	0.001	0.92
Demand of private (morning)	0.80	0.01	0.999	0.08
Demand of dual practice	0.73	-	0.77	-
Demand of private (afternoon)	0.27	-	0.23	-
Patient welfare in the morning	162.26	168.60	159.40	163.91
Patient welfare in the afternoon	169.73	153.72	168.31	151.33
Welfare of private facility	33.22	50.11	40.19	58.46
Welfare of public facility	7.50	37.83	0.27	42.10
Transfer	-	42.17	-	47.60
Total welfare	372.70	368.14	368.17	368.20

The opposite situation depicts in the point of F and point H where total welfare NI is larger than total welfare DN. Under everything keeps constant, the points where DN< NI are the starting points where all the values of NI will be lower than DN. Our simulation is using interval of $0 \leq \widetilde{p_1} \leq 60$, the point is in $\widetilde{p_1} = 48$. We increase the level of accuracy into double decimal digits and the points that fulfilled requirements are 48.00$\leq \widetilde{p_1} \leq 48.25$. These are the points where total welfare of DN<NI and the conditions are still met.

Hence the result is reliable. Beyond this interval, the total welfare of NI is always higher than DN, although the conditions are no longer met.

Under dual practice, the demand in public facility might be low in contrast with the very high demand of private facility. The high price of public facility cannot lift up the profit from the low demand. Hence the profit in public facility will get lower and only contribute small portion to the total welfare. At the same time, under insurance regime, the demand of public facility might be very high and demand of private facility in the morning is very low. The public facility will get optimal profit from the high demand along with the high price in public facility. Under insurance regime, however, the private facility still gains profit because all patients only visit private facility in the afternoon. Under dual practice regime, the amount loss in public sector significantly affected the total welfare, and the result is that the total welfare in DN will be lower than NI situation.

Remark 9: *Although the comparison between four regimes does not show dominance effect of one policy among the other but in general, having dual practice provides higher welfare compare to having insurance coverage in the long run.*

The comparison of total welfare between four regimes will be concentrated to analyze the involvement of variables such as price and demand. In general, having dual practice in the system will bring higher benefit compare to no dual practice situation, regardless of the insurance situation. When we simplified the comparison only between having dual practice or no dual practice, it is shown that having dual practice in the system increases the total welfare of the system. The dual practice and insurance give different directions on how they both affected the total welfare. As mentioned before, the magnitude of dual practice is increasing the welfare by push down the price in private sector. The patients benefit the price effect as they pay a lower price in private sector among the four situations. In contradiction, the insurance makes the price in private goes up and private facility enjoys the higher level of welfare. Patients are not suffered much from the higher price because they pay lower cost under insurance but the government has to pay the transfer. Hence it reduces the total welfare under insurance regime. When patient's welfare from having insurance is higher than the government transfer to subsidize insurance, then having dual practice provides more benefit compare to no insurance. But when government has to pay higher insurance subsidy compare to patient welfare from having insurance, then in general we can say that having insurance is less benefit compare to no insurance regime.

Figure 2.8 shows the relationship between price in public facility and welfare level. The higher the price in public sector, the higher the price in private facility, the higher the quality provided in the facility. The dual practice will reduce the price in private while the insurance tends to increase the price in the private facility.

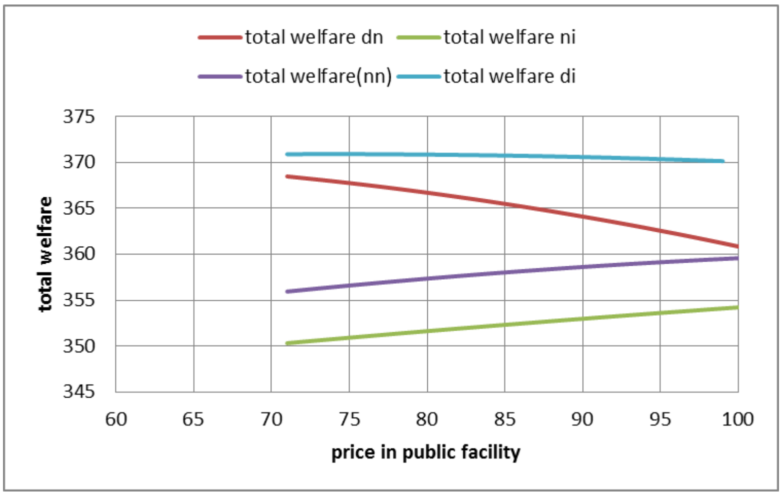


Figure 2. 8: Total welfare and public price

The comparison of the total welfare in the long run among four different regimes suggests that the regime of dual practice with insurance benefits the most in term of welfare. In general, having dual practice gives more benefit in term of welfare due to a lower price from a patient's perspective. The welfare in facility gains more under insurance regime, as the facility enjoys the high price and increasing demand because of insurance coverage on treatment fee. The transfer in our model only occurs when the government transfers the amount of insurance coverage to the insurance company. The government has to compensate more insurance transfer under the system with insurance. Our example shows that total welfare under dual practice-with insurance might be the highest level because the combination of benefit from patients and providers is higher than the government transfer to insurance subsidy. Patients benefit comes from lower price due to dual practice in the system and insurance coverage. While provider enjoys more benefit from profit of higher price and undisturbed demand because patients are covered with insurance.

Ones should note that in our theoretical approach, we use the adjusted price in equilibrium that represents the long term situation rather than short term. We refer to the fact in real case that price and quality cannot suddenly change under some circumstances, such as regulation, socialization, and supply availability. The primary consideration in our recommendation about dual practice and insurance in this chapter is based on our construction of the total welfare assessment in four regimes. For example the government transfer is assumed will cover the whole insurance subsidy in the system while later in our empirical study it will not be the case. The welfare analysis will not appear in the next chapter when we discuss the dual practice in demand of health care. We will use our general framework of dual practice and insurance health care policy when analyzing the patient perspective on which facility he visited during the illness period: public, private or non-physician facility (traditional healers).

2. 6 Welfare effects in the short run

In this sub chapter, we will analyze the effect of dual practice and insurance in short run using welfare function framework. The principal idea is to measure the change in welfare function immediately after dual practice and insurance are being introduced in the system. We basically compare the total welfare under the first case of no dual practice-no insurance to the case with dual practice and the case with insurance, separately. We assume that private provider will take longer time to adopt the price and quality equilibrium. Allowing dual practice and insurance is a shock to the system. The short run welfare describes the impact of that shock under no reaction of the other players during the period right after the policy is launched and the new price and quality equilibrium, being applied. Thus the magnitude of each effect will be more clearly to justify. In the short run welfare there is no change in equilibrium values (which means that if the equilibrium is the same, there is no change in welfare either). After the shock which is after adjustment in all decisions to the new context, the long run equilibrium will have different values for the variables as explained in previous sub chapter (2.5).

2. 6.1 The short run effect after introduction of insurance

We recall the demand function in the morning for the initial case, no dual practice-no insurance (NN). The demand of public and private facility can be written as:

$$x_1^{am} = \frac{t + \widetilde{q_1} - \widetilde{sp_1} - q_2{}^{NI} + sp_2{}^{NI}}{2t} \tag{2. 80}$$

$$x_2^{am} = (1 - x_1^{am}) = \frac{t - \widetilde{q_1} + \widetilde{sp_1} + q_2{}^{NI} - sp_2{}^{NI}}{2t} \tag{2. 81}$$

In the case when dual practice is not in the system, all patients will visit private provider with a private physician in the afternoon.

The solution of price and quality in equilibrium are:

$$p_2{}^{NI} = \frac{3t - \widetilde{q_1} + \widetilde{sp_1} + (s - \frac{1}{2\varphi_2 t})c_2}{2\left(s - \frac{1}{4\varphi_2 t}\right)} \tag{2. 82}$$

$$q_2{}^{NI} = \frac{p_2{}^{NI} - c_2}{2\varphi_2 t} \qquad \textbf{(2.83)}$$

To calculate the short run effect caused by insurance, we replace the equilibrium $p_2{}^{NI}$ with fixed price and quality from the initial case of no dual practice-no insurance, $p_2{}^{NN}$ and $q_2{}^{NN}$ as in (2.16) and (2.37).

$$p_2{}^{NI^*} = p_2{}^{NN} \qquad \textbf{(2.84)}$$

$$q_2{}^{NI^*} = q_2{}^{NN} \qquad \textbf{(2.85)}$$

The demand in the morning becomes:

$$x_1^{am*} = \frac{t + \widetilde{q_1} - s\widetilde{p_1} - q_2{}^{NI^*} + sp_2{}^{NI^*}}{2t} \qquad \textbf{(2.86)}$$

$$x_2^{am*} = (1 - x_1^{am})^* = \frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI^*} - sp_2{}^{NI^*}}{2t} \qquad \textbf{(2.87)}$$

Patient in the morning can choose between public or private facility. The demand in the afternoon is one because all patients visit the private facility.

The total welfare in the short run consists of patient's welfare in the morning and in the afternoon, the welfare of private facility, the welfare of public facility, the welfare of insurance company, and government transfer. We will first explain for each element of total welfare.

The welfare of patient in the morning comes from the patient's utility when they decide to visit the public or private facility. The price of the private facility comes from the initial case of no dual practice-no insurance to describe that the private facility has not adapted to equilibrium price in the short run. The welfare of patient in the morning now contains the effect of insurance that is seen through the insurance rate.

$$welfare\ of\ patient\ in\ the\ morning(NI^*)$$
$$= \int_0^{x_1^{am^*}} (y + \widetilde{q_1} - s\widetilde{p_1} - tx)dx$$
$$+ \int_{x_1^{am^*}}^1 \big(y + q_2{}^{NI^*} - sp_2{}^{NI^*} - t(1-x)\big)dx \qquad \textbf{(2. 88)}$$

Patients only visit the private facility in the afternoon so that the demand of patient will be equal to one.

$$welfare\ of\ patient\ in\ the\ afternoon(NI^*)$$
$$= \int_0^1 \big(y + q_2{}^{NI^*} - sp_2{}^{NI^*} - t(1-x)\big)dx \qquad \textbf{(2. 89)}$$

The welfare of each health care facility is:

$$welfare\ of\ private\ facility(NI^*)$$

$$= \int_{x_1^{am^*}}^{1} D_2^{am*}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(p_2 - c_2)dx$$

$$+ \int_0^1 1.\left({p_2}^{NI^*} - c_2\right)dx - \varphi_2 \frac{{q_2}^{NI^*2}}{2} \qquad \textbf{(2. 90)}$$

$$welfare\ of\ public\ facility(NI^*)$$

$$= \int_0^{x_1^{am*}} D_1^{am*}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(\widetilde{p_1} - c_1)dx$$

$$- \varphi_1 \frac{\widetilde{q_1}^2}{2} \qquad \textbf{(2. 91)}$$

The welfare of insurance company is a break even condition because the government is assumed to pay all part of insurance to the insurance company and the insurance company pays the same amount to health care facility.

$$
\begin{aligned}
& welfare\ of\ insurance\ company(NI^*) \\
& = \left(\int_0^{x_1^{am^*}} D_1^{am}\left(p_2{}^{NI^*}, \widetilde{p_1}, q_2{}^{NI^*}, \widetilde{q_1}\right)(1-s)\widetilde{p_1} \right. \\
& + \int_{x_1^{am^*}}^1 D_2^{am}\left(p_2{}^{NI^*}, \widetilde{p_1}, q_2{}^{NI^*}, \widetilde{q_1}\right)(1-s)p_2 \\
& \left. + \int_0^1 D_2^{pm}\left(p_2{}^{NI^*}, q_2{}^{NI^*}\right)(1-s)p_2{}^{NI^*} \right) \\
& - \left(\int_0^{x_1^{am^*}} D_1^{am}\left(p_2{}^{NI^*}, \widetilde{p_1}, q_2{}^{NI^*}, \widetilde{q_1}\right)(1-s)\widetilde{p_1} \right. \\
& + \int_{x_1^{am^*}}^1 D_2^{am}\left(p_2{}^{NI^*}, \widetilde{p_1}, q_2{}^{NI^*}, \widetilde{q_1}\right)(1-s)p_2{}^{NI^*} \\
& \left. + \int_0^1 D_2^{pm}\left(p_2, q_2{}^{NI^*}\right)(1-s)p_2{}^{NI^*} \right) = 0
\end{aligned}
\tag{2.92}
$$

The last part of the total welfare is the government transfer. We include the government transfer that consists of transfer to the insurance company. In our setting, we do not include the government activity on financing the public facility in the timeline of decisions. Usually, the government raises funds by collecting the tax to pay health care expenditure. While the citizen pays the tax and in returns, they get totally free or partly subsidized health care treatment. In our framework, we simplify the case by making government pays all insurance coverage to the insurance company without any additional cost of distortion. We refer to the decision stage in the sub chapter of 2.2; the government decision only on selecting health care access policy using dual practice and insurance and also setting the price and quality level in public provider. Those decisions are taken as given in our framework. Furthermore, the insurance part is an additional burden for government and becomes a cost component that will reduce the total welfare.

$$
\begin{aligned}
&government\ transfer \\
&\qquad = \left(\int_0^{x_1^{am*}} D_1^{am}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(1-s)\widetilde{p_1} \right. \\
&\qquad + \int_{x_1^{am*}}^1 D_2^{am}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(1-s)p_2 \\
&\qquad \left. + \int_0^1 D_2^{pm}\left({p_2}^{NI^*}, {q_2}^{NI^*}\right)(1-s){p_2}^{NI^*} \right)
\end{aligned} \quad \textbf{(2. 93)}
$$

The total welfare is the summation of all components minus the government transfer.

$$
\begin{aligned}
&total\ welfare(NI^*) \\
&= \int_0^{x_1^{am*}} (y + \widetilde{q_1} - s\widetilde{p_1} - tx)dx \\
&+ \int_{x_1^{am*}}^1 \left(y + {q_2}^{NI^*} - s{p_2}^{NI^*} - t(1-x)\right)dx \\
&+ \int_0^1 \left(y + {q_2}^{NI^*} - s{p_2}^{NI^*} - t(1-x)\right)dx \\
&+ \int_{x_1^{am*}}^1 D_2^{am}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(p_2 - c_2)dx \\
&+ \int_0^1 1.\left({p_2}^{NI^*} - c_2\right)dx - \varphi_2 \frac{{q_2}^{NI^*2}}{2} \\
&+ \int_0^{x_1^{am*}} D_1^{am}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(\widetilde{p_1} - c_1)dx \\
&- \varphi_1 \frac{\widetilde{q_1}^2}{2} \\
&- \left(\int_0^{x_1^{am*}} D_1^{am}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(1-s)\widetilde{p_1}\right. \\
&+ \int_{x_1^{am*}}^1 D_2^{am}\left({p_2}^{NI^*}, \widetilde{p_1}, {q_2}^{NI^*}, \widetilde{q_1}\right)(1-s)p_2 \\
&\left. + \int_0^1 D_2^{pm}\left({p_2}^{NI^*}, {q_2}^{NI^*}\right)(1-s){p_2}^{NI^*}\right) \qquad \textbf{(2. 94)}
\end{aligned}
$$

2. 6.2 The short run effect after introduction of dual practice

We show the demand of health care construction again in order to demonstrate the short run effect of dual practice in the system. Demand in the morning in the case of dual practice-no insurance (DN):

$$x_1^{am} = \frac{t + \widetilde{q_1} - \widetilde{p_1} - q_2{}^{DN} + p_2{}^{DN}}{2t} \tag{2. 95}$$

$$x_2^{am} = (1 - x_1^{am}) = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DN} - p_2{}^{DN}}{2t} \tag{2. 96}$$

Demand in the afternoon (DN) now consists of demand for dual practice facility and demand for private facility:

$$x_1^{pm} = \frac{t + q_1{}^{DN} - p_1{}^{DN} - q_2{}^{DN} + p_2{}^{DN}}{2t} \tag{2. 97}$$

$$x_2^{pm} = \frac{t - q_1{}^{DN} + p_1{}^{DN} + q_2{}^{DN} - p_2{}^{DN}}{2t} \tag{2. 98}$$

The equilibrium price in private sector,

$$p_2{}^{DN} = \frac{\left(2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2}}{\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)} \tag{2. 99}$$

$$q_2{}^{DN} = \frac{p_2{}^{DN} - c_2}{\varphi_2 t} \tag{2. 100}$$

The solution of price in the dual practice, p_1 in the equilibrium is,

$$p_1{}^{DN} = \frac{t + \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t} + \left(1 - \frac{1}{\varphi_2 t}\right) p_2{}^{DN}}{\left(2 - \frac{1}{2\varphi_1 t}\right)} \quad \textbf{(2. 101)}$$

$$q_1{}^{DN} = \frac{p_1{}^{DN} - c_2}{2\varphi_1 t} \quad \textbf{(2. 102)}$$

To calculate the short term welfare caused by dual practice, we replace the equilibrium price with the fixed price from the no dual practice-no insurance (NN). In this case we use the price and quality in base case $p_2{}^{NN}$ and $q_2{}^{NN}$ as in (2.16) and (2.37).

$$p_2{}^{DN^*} = p_2{}^{NN} \quad \textbf{(2. 103)}$$

$$q_2{}^{DN^*} = q_2{}^{NN} \quad \textbf{(2. 104)}$$

We then recalculate the price and quality in dual practice facility p_1 and q_1 for the short term using the $p_2{}^{DN^*}$and $q_2{}^{DN^*}$ that we defined before in 2.100 and 2.101, so that.

$$p_1{}^{DN^*} = \frac{t + \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t} + \left(1 - \frac{1}{\varphi_2 t}\right) p_2{}^{DN^*}}{\left(2 - \frac{1}{2\varphi_1 t}\right)} \quad \textbf{(2. 105)}$$

$$q_1{}^{DN^*} = \frac{p_1{}^{DN^*} - c_2}{2\varphi_1 t} \quad \textbf{(2. 106)}$$

The demand of each facility in the morning for short term becomes:

$$x_1^{am*} = \frac{t + \widetilde{q_1} - \widetilde{p_1} - q_2{}^{DN^*} + p_2{}^{DN^*}}{2t} \quad \textbf{(2. 107)}$$

$$\boldsymbol{x_2^{am*} = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DN^*} - p_2{}^{DN^*}}{2t}} \quad \textbf{(2. 108)}$$

Demand in the afternoon between dual practice facility and private facility for short term are:

$$\boldsymbol{x_1^{pm*} = \frac{t + q_1{}^{DN^*} - p_1{}^{DN^*} - q_2{}^{DN^*} + p_2{}^{DN^*}}{2t}} \quad \textbf{(2. 109)}$$

$$x_2^{pm*} = \frac{t - q_1{}^{DN^*} + p_1{}^{DN^*} + q_2{}^{DN^*} - p_2{}^{DN^*}}{2t} \quad \textbf{(2. 110)}$$

We compose the total welfare function that now consists of private and quality that come from the fix price and quality of the initial case, no dual practice-no insurance. The welfare of patient in the morning in the dual practice (short run) will be equal to the welfare of patient from visiting public facility and private provider.

$$welfare\ of\ patient\ in\ the\ morning(DN^*)$$

$$= \int_0^{x_1^{am*}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx$$

$$+ \int_{x_1^{am*}}^1 \left(y + q_2{}^{DN^*} - p_2{}^{DN^*} - t(1-x)\right)dx \tag{2. 111}$$

The welfare of patient in the afternoon comes from the patient's utility visiting dual practice facility and private facility.

$$welfare\ of\ patient\ in\ the\ afternoon(DN^*)$$

$$= \int_0^{x_1^{pm^*}} \left(y + q_1{}^{DN^*} - p_1{}^{DN^*} - tx\right)dx$$

$$+ \int_{x_1^{pm^*}}^1 \left(y + q_2{}^{DN^*} - p_2{}^{DN^*} - t(1-x)\right)dx \tag{2. 112}$$

The welfare from public health care facility is:

$$welfare\ of\ public\ facility(DN^*)$$

$$= \int_0^{x_1^{am}{}_*} D_1^{am}\left(p_2{}^{DN^*}, \widetilde{p_1}, q_2{}^{DN^*}, \widetilde{q_1}\right)(\widetilde{p_1} - c_1)dx$$

$$- \varphi_1 \frac{\widetilde{q_1}^2}{2} \tag{2. 113}$$

The welfare of private facility and dual practice facility is:

$$welfare\ of\ private\ facility(DN^*)$$

$$= \int_{x_1^{am^*}}^{1} D_1^{am}\left(p_2{}^{DN^*}, \widetilde{p_1}, q_2{}^{DN^*}, \widetilde{q_1}\right)\left(p_2{}^{DN^*} - c_2\right)dx$$

$$+ \int_{x_1^{pm^*}}^{1} D_1^{pm}\left(p_2{}^{DN^*}, p_1{}^{DN^*}, q_2{}^{DN^*}, q_1\right)\left(p_2{}^{DN^*}\right.$$

$$\left. - c_2\right)dx - \varphi_2 \frac{q_2{}^{DN^{*2}}}{2}$$

$$+ \int_{0}^{x_1^{pm^*}} D_1^{pm}\left(p_2{}^{DN^*}, p_1{}^{DN^*}, q_2{}^{DN^*}, q_1\right)\left(p_1{}^{DN^*}\right.$$

$$\left. - c_1\right)dx - \varphi_1 \frac{q_1{}^{DN^{*2}}}{2} + \qquad \textbf{(2. 114)}$$

There is no insurance in the system so that the welfare of insurance company will be equal to zero from the construction. The government will not concern to do any transfer and in this case the government transfer is zero. The total welfare function for short term caused by dual practice can be written as:

$$
\begin{aligned}
&total\ welfare(DN^*)\\
&= \int_0^{x_1^{am^*}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx\\
&+ \int_{x_1^{am^*}}^1 \left(y + {q_2}^{DN^*} - {p_2}^{DN^*} - t(1-x)\right)dx\\
&+ \int_0^{x_1^{pm^*}} \left(y + {q_1}^{DN^*} - {p_1}^{DN^*} - tx\right)dx\\
&+ \int_{x_1^{pm^*}}^1 (y + {q_2}^{*dn} - {p_2}^{*dn} - t(1-x))dx\\
&+ \int_0^{x_1^{am^*}} D_1^{am}\left({p_2}^{DN^*}, \widetilde{p_1}, {q_2}^{DN^*}, \widetilde{q_1}\right)(\widetilde{p_1} - c_1)dx\\
&- \varphi_1 \frac{\widetilde{q_1}^2}{2}\\
&+ \int_{x_1^{am^*}}^1 D_2^{am}\left({p_2}^{DN^*}, \widetilde{p_1}, {q_2}^{DN^*}, \widetilde{q_1}\right)\left({p_2}^{DN^*}\right.\\
&\left.- c_2\right)dx \int_{x_1^{pm^*}}^1 D_2^{pm}\left({p_2}^{DN^*}, {p_1}^{DN^*}, {q_2}^{DN^*}, q_1\right)\left({p_2}^{DN^*}\right.\\
&\left.- c_2\right) - \varphi_2 \frac{{q_2}^{DN^*2}}{2} dx\\
&+ \int_0^{x_1^{pm^*}} D_1^{pm}\left({p_2}^{DN^*}, {p_1}^{DN^*}, {q_2}^{DN^*}, q_1\right)\left({p_1}^{DN^*}\right.\\
&\left.- c_1\right)dx - \varphi_1 \frac{{q_1}^{DN^*2}}{2}
\end{aligned}
\qquad \textbf{(2. 115)}
$$

2. 6.3 Insurance or dual practice?

The comparison of total welfare between no dual practice-no insurance (NN), a short run of no dual practice-insurance (NI^*), and a short run of dual practice-no insurance(DN^*) will provide explanations in which policy has the optimal effect in short run in term of welfare.

Remark 10: *In short run, where there is no adjustment on price and quality of private facility using equilibrium price and quality of private facility, having higher percentage of insurance coverage makes the total welfare is lower compare to total welfare under dual practice regime.*

The Figure 2.D.11 in the Appendix 2D provides the comparison of total welfare with the increasing price in public $\widetilde{p_1}$, there is no insurance in the system, and the NI^* will be equal to NN. We put a small amount of insurance rate, $(1 - \mathrm{s} = 0.2)$ and keep other variables being constant. The s is the percentage of treatment fee paid by patients, and $(1 - \mathrm{s})$ is the percentage of treatment fee paid by insurance company. The figure also shows that increasing insurance makes total welfare goes up higher than the base state of no dual practice-no insurance (NN) but still bellow of total welfare of DN^*. The more we put the insurance rate in the system, the total welfare of NI^* is getting higher than NN, as shown in Figure 2.D.12 and Figure 2.D.13 of Appendix 2D, when the insurance rate are $(1 - \mathrm{s} = 0.2)$ and $(1 - \mathrm{s} = 0.8)$. Patients benefit more from having insurance coverage, while private facility gains more profit from higher price, hence these two welfare components will be higher than government subsidy. The total welfare under dual practice is still the highest because patients benefit from lower price in private facility is still dominance although patients have to pay the full price. Dual practice regime also eliminates the government subsidy that will subtract total welfare in our welfare composition. In general we can conclude that the additional insurance and dual practice increase the total welfare in short term compare to the null state of no dual practice-no insurance regime.

We produce a simulation using random values for the variables and constraint based on the previous result of price and welfare function in sub Chapter 2.5.5. The cost of quality in the public and private facilities are greater than zero, $\varphi_1 > 0,\ \varphi_2 > 0$. The cost of treatment in public and private facilities is equal or greater than zero, $c_1 > 0, c_2 > 0$. The government decision on quality and price in the public facility are set to be greater than zero, $\widetilde{q_1} \geq 0, \widetilde{p_1} > 0$. The other components such as travel cost and income also should be larger than zero, $t > 0, y > 0$. We choose value of variables that guarantee the result on private price, private quality and welfare under some requirements. The price and quality should be larger than zero. The demand function appears in the interval [0,1] as the basic assumption. The welfare components are also larger than zero, for example the welfare of private facility and the welfare of public facility. The latter requirement will ensure that the health care facility balance their revenue over the cost. The private facility can have profit to keep providing services, while the public facility keeps the positive margin to run the facility. To get a clearer picture on the pattern of the total welfare in these three comparisons, we set only one variable to change, which is a variable of price in the public facility, and keep other variables in constant. In this particular figure, the values of each variable are: $\varphi_1 = \varphi_2 = 2; \widetilde{q_1} = 0.1;\ t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100;\ 0 < s \leq 1$.

Remark 11: *For any insurance coverage between 0 and 1, short run welfare of patient in the morning and in the afternoon under insurance shows higher value compare to patient welfare under dual practice regime.*

The welfare of patient in the morning between three comparisons appears of base state of no dual practice-no insurance, short run insurance effect, and short run dual practice effect in Figure 2.D.14 of the Appendix 2D. The welfare of patient in the morning in NN is equal in dual practice because the dual practice uses fixed price in NN. Figure 2.D.15 of Appendix 2D shows the comparison of welfare for the patient in the afternoon. The insurance rate, in this case, is equal 0.5. The welfare of patient in the afternoon with insurance is the highest level. The increasing price of the public, the demand of public will decrease, and the demand for private is increased. Patient in the morning visit more private facility is ignoring the increasing price due to the insurance existence.

The result of patient welfare only shows that in general patients also enjoy the insurance coverage in short run effect. They will get more benefit because they do not need to pay the whole part of treatment fees. Patients will be less sensitive with the increasing price that comes along with the increasing insurance rate.

Remark 12: *In the short run, the profit of public and private facility might gain benefit or might gain loss in dual practice regime compared to insurance regime.*

Figure 2.D.16 of the Appendix 2D shows the profit in public facility with the price in public. The profit of the public at NN is equal to DN^* due to a fixed price in private facility. Under dual practice regime, patients might prefer visit public facility, hence the demand in public is increasing and welfare in public facility is also increasing. Under insurance regime, many patients might be interesting to visit private facility, so the

demand in public is decreasing. It brings loss in welfare of public facility under insurance regime.

Figure 2.D.17 of the Appendix 2D shows welfare of private facility with the price in public facility. Under insurance regime, private facility gets more benefit from the increasing price and increasing demand of private facility. Patients might choose private facility because they now are covered with insurance that can leave part of the treatment fees. While under dual practice, private facility has to decrease the price but it is not immediately increasing the demand. In this comparison, private facility might get higher welfare under insurance compare to welfare under dual practice.

Remark 13: *Total welfare effect in short run between dual practice and insurance shows no dominance policy as the welfare of having dual practice might be higher or lower than the welfare of having insurance in the system. The short run welfare uses non-adjusted price and quality of private facility..*

Depending on parameter values, the total welfare in short run under dual practice regime might be lower or higher than insurance regime after meeting the requirements condition. We illustrate it in Figure 2.9, and the specific values are in Table 2.5. The simulation uses a specific values of $\varphi_1 = 2$; $\varphi_2 = 2; \widetilde{q_1} = 0.2$; $t = 25; c_1 = 5$; $c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100$; $s = 0$. The values that satisfied the conditions are $30 \leq \widetilde{p_1} \leq 78$, or along line EF for short run effect of insurance and line of GH for short run effect of dual practice. The requirement conditions are the price component, quality component, and welfare values must be higher than zero. The demand based on our definition at the beginning must be between zero and one.

The total welfare of dual practice might be smaller than total welfare of insurance regime, when a certain price offered by public facility under dual practice regime makes most of patients in the morning go to the public facility rather than private facility. The demand in public facility reaches its peak point while in contrast the demand in private facility is very low. The pattern is similar in the afternoon, where most patients choose the dual practice facility over the private facility. The lowered price in private sector combines with the low demand of private facility will reduce the total welfare in aggregate and the profit from public facility cannot compensate the loss from private sector. The total welfare of DN^* that smaller than NI^* is shown in the points of B compares to point A in Figure 2.9. The detailed parameter values are presented in Table 2.5.

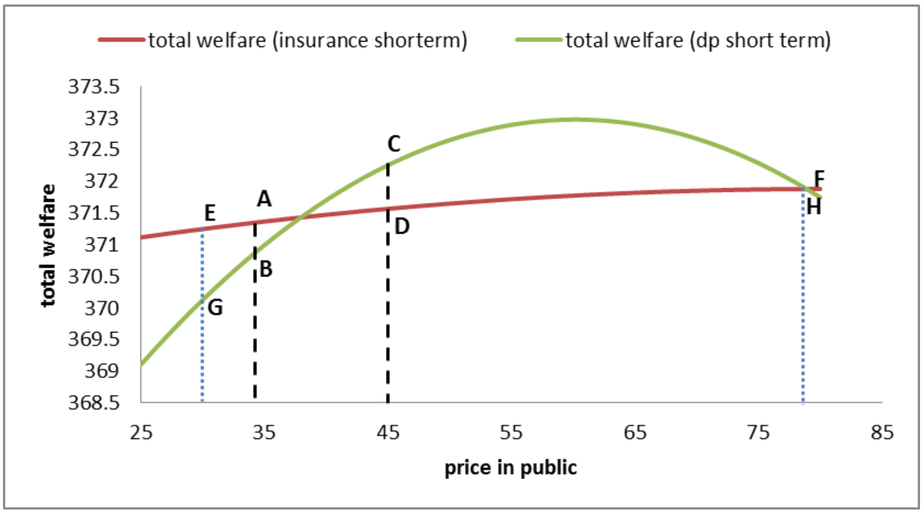


Figure 2. 9 Total welfare of dual practice and insurance in short run

Table 2. 5 Parameter values on total welfare of dual practice and insurance in short run

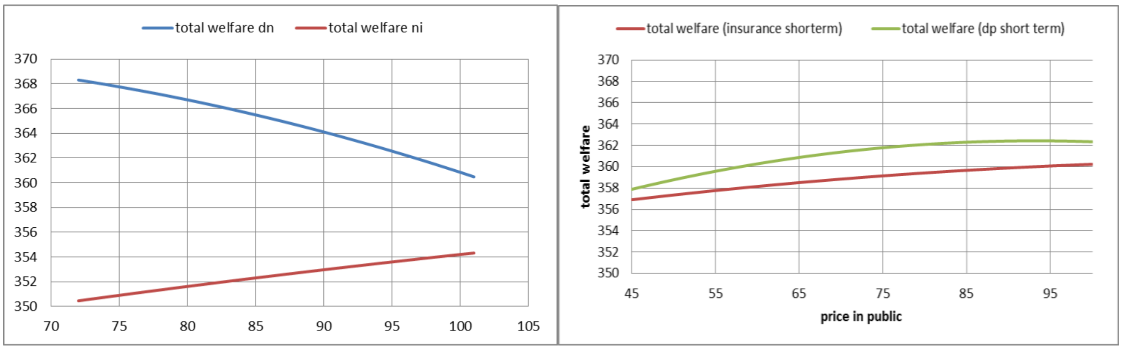
Variables	DN*>NI*		DN*<NI*	
	C (DN)	D (NI)	B (DN)	A (NI)
φ_1	2			
φ_2	2			
c_1	5			
c_2	5			
t	25			
$\widetilde{q_1}$	0.2			
s	0.3			
y	200			
$\widetilde{p_1}$	45	45	35	35
Demand of public in the morning	0.85	0.60	0.95	0.63
Demand of private (morning)	0.15	0.40	0.05	0.37
Demand of dual practice	0.83	-	0.78	-
Demand of private (afternoon)	0.17	-	0.22	-
Patient welfare in the morning	143.65	178.23	152.77	180.63
Patient welfare in the afternoon	142.65	169.27	145.60	170.73
Welfare of private facility	52.50	80.51	44.26	71.90
Welfare of public facility	33.81	23.90	28.36	18.84
Transfer	-	80.35	-	70.74
Total welfare	**372.61>371.56**		**370.99<371.36**	

The total welfare of dual practice might be lower than total welfare of insurance in short run. Under dual practice regime, the demand of public is very high while the demand of private facility is low in the morning. In the afternoon, the demand of dual practice is high and it is combining with the low level of demand in the private. The similar situation happens under insurance regime when the demand of public is high while demand of private is low in the morning. However, the private facility still gains significant profit because in the afternoon under insurance regime all patients will visit private facility. The low level of demand in private sector under dual practice regime has made significant loss in the short run facility welfare. Hence the total welfare of dual practice will be lower than insurance regime.

The more common situation is when total welfare under dual practice is more significant than insurance as pointed in point C compare to point D in Figure 2.9 and Table 2.5. Under dual practice, the demand of health care in the morning starts shifting from public to private facility again, the demand of public facility is still high but not too high, and the demand of private facility is low but not too low. In the afternoon, the demand of dual practice is high, and the demand of private is also high. Under insurance regime, the demand between public is still high, and the demand of private is still low. Government pays the insurance subsidy that will reduce the total welfare under insurance regime. The profit loss from the low level of demand of private sector is not severely harmed the total welfare under dual practice. The shifting demand still benefits compare to welfare loss from government transfer in insurance regime hence the total welfare of dual practice is still higher than total welfare under insurance regime.

Remark 14: *The difference of welfare effect between dual practice and insurance coverage in the long run is more significant than the difference between two policies in the short run.*

In order to get better description on the comparison between long run and short run effect of dual practice and insurance, we apply different set of variables, $\varphi_1 = 2;\ \varphi_2 = 2;\ t = 40;\ c_1 = 5;\ c_2 = 5; 1 \leq \widetilde{p_1} \leq 100; \widetilde{q_1} = 0.1;\ y = 200;\ s = 0.6$, that appears in Figure 2.10A for long run effect, where conditions are met at $71 \leq \widetilde{p_1} \leq 100$ and Figure 2.10B for the short run effect where the conditions are met at $45 \leq \widetilde{p_1} \leq 100$. Both short and long run effects show that dual practice has higher total welfare compare to insurance effect.



(A) **(B)**

Figure 2. 10 The total welfare of long run effect and short run effect

Under insurance regime, patients might benefit from insurance coverage while private facility gets more profit from higher price and demand of private facility. Our example shows that those benefits are smaller than the loss from government paying the transfer for the insurance subsidy. The patient's benefit from paying lower price in dual practice regime shows more significant effect on the total welfare. This profit is added with the benefit from the fact that government transfer zero amount because no insurance in the system. The large difference between total welfare under dual practice regime and insurance regime in the long run comes from the equilibrium price and equilibrium quality in the construction. Our short run welfare is based on the difference between two policies with the base state of no dual practice-no insurance which have lower price and quality than the equilibrium price and quality. The result describes the real situation where the effect of two policies of dual practice and insurance give significant difference in long run. The two policies will need more time to be applied in the system. In the short run, the introduction of two policies shows light impact as the policies need adaptions from the initial situation of no dual practice-no insurance situation. For example, dual practice policy needs time for preparing the dual practice facility and insurance subsidy needs patient's identification and budget allocation to implement the regulation.

2.7 The policy implication

In the previous sub sections of 2.3 and 2.4, we explained the construction of price and quality in health care system in different situations which are combination between dual practice regulation and insurance scheme in the model. The critical motivation behind the study of dual practice is the access of health care. The main reason of dual practice regulation, in the beginning, is to enlarge the patient access to health care. The insurance, however, is also a valuable tool to access health care from financial perspective. The insurance can relieve the patient's financial burden caused by treatment fee. The previous result shows that the additional insurance scheme in the model has made the price in private sector is higher compare to the situation without insurance.

This sub section will analyze the changes in insurance coverage as a policy recommendation to enlarge the health care access in comparison of dual practice regulation. We measure the insurance coverage in a different definition. Before, the insurance is the percentage of treatment fee that will be paid by the insurance company. In this section we modified the insurance as a percentage of population who has insurance. This means that some people have benefit from insurance scheme by lifting the treatment fee in any percentage. It is necessary to adjust the model to show the insurance definition change will affect to the price of private facility.

We start with simple modification on the price determination, where we add a β, which represents to the proportion of insured people in the system. The β equal to zero means that no one in the population has insurance scheme, while the β equal to one means that all individuals in the population has insurance scheme. The proportion of uninsured people is $(1-\beta)$. From the previous equation in 2.3, we have s as a percentage of treatment fee paid by patient. The s equal to zero means that patient is fully insured, no need to pay any treatment fee in health care facility. The s lies between zero and one. We form the profit of private facility with private physician as the additional function of:

$$\pi_{pv} = \beta(Demand\ of\ s = 0) + (1-\beta)(Demand\ of\ 0 < s < 1) \quad \textbf{(2. 116)}$$

In the profit function of private facility, we include all the demand in the morning and in the afternoon for population with fully insured and the rest of population that still has to pay for the treatment fee from their own pocket.

$$\pi_{pv} = \beta[D_{s=0}^{am}(p_2, \widetilde{p_1}, q_2, \widetilde{q_1})(p_2 - c_2)]$$
$$+ \left[D_{s=0}^{pm}(p_2, p_1, q_2, q_1)(p_2 - c_2)\right]$$
$$+ (1 - \beta)[D_{s=1}^{am}(p_2, \widetilde{p_1}, q_2, \widetilde{q_1})(p_2 - c_2)]$$
$$+ (1 - \beta)\left[D_{s=1}^{pm}(p_2, p_1, q_2, q_1)(p_2 - c_2)\right] - \varphi_2 \frac{{q_2}^2}{2}$$

(2. 117

The profit function on the dual practice facility now consists of population with full insurance and the rest of the population.

$$\pi_{DP} = \beta(Demand\ of\ s = 0) + (1 - \beta)(Demand\ of\ 0 < s < 1) \quad \textbf{(2. 118)}$$

The profit function in dual practice facility consists of demand in the afternoon as this facility only open in the afternoon. We rewrite it as,

$$\pi_{DP} = \beta\left[D_{s=0}^{pm}(p_2, p_1, q_2, q_1)(p_2 - c_2)\right]$$
$$+ (1 - \beta)\left[D_{s=1}^{pm}(p_2, p_1, q_2, q_1)(p_2 - c_2)\right] - \varphi_2 \frac{{q_2}^2}{2} \quad \textbf{(2. 119)}$$

The next step is to find price and quality equilibrium in the private facility by solving the first order condition for each profit function in private facility and dual practice facility. The process is the same as before but now using the additional component of β. We find the price and quality equilibrium by setting $\frac{\partial \pi_{pv}}{\partial p_2} = 0, \frac{\partial \pi_{pv}}{\partial q_2} = 0, \frac{\partial \pi_{pv(DP)}}{\partial p_1} = 0, \frac{\partial \pi_{pv(DP)}}{\partial q_1} = 0$. The detailed works appear in the Appendix 2C.1 and here we only provide the final solution. The price in the private facility is:

$$p_2 = \frac{\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} + \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right)\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right) + \left(t + \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1\right)\left((1-\beta) - \frac{1}{2\varphi_1 t}\right)}{\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)}$$

(2. 120)

Remark 15: *Private facility will set higher price when more people are covered in insurance scheme.*

To support our claim on the effect of percentage of insured population to the price in private facility, we investigate the effects of β on the price on $p_2$by solving the second order condition and find that $\frac{\partial p_2}{\partial \beta} > 0$. The checking on second order condition and the complete result of $\frac{\partial p_2}{\partial \beta}$ are provided in Appendix 2C2. The higher portion of insured population has made private facility to react by increasing the price. The Figure 2.11 depicts the change of insurance coverage in the population from 0.4 to 0.8 for example. The price of private facility goes up from $p_{2(0.4)}$ to $p_{2(0.8)}$. The result emphasizes our result before that the policy to increase access by putting insurance in the system makes the price in private higher than without insurance in the system. The situation relates with the condition when private facility charges higher price of treatment without losing the demand because there is insurance coverage that relieve the treatment fee for part of population.

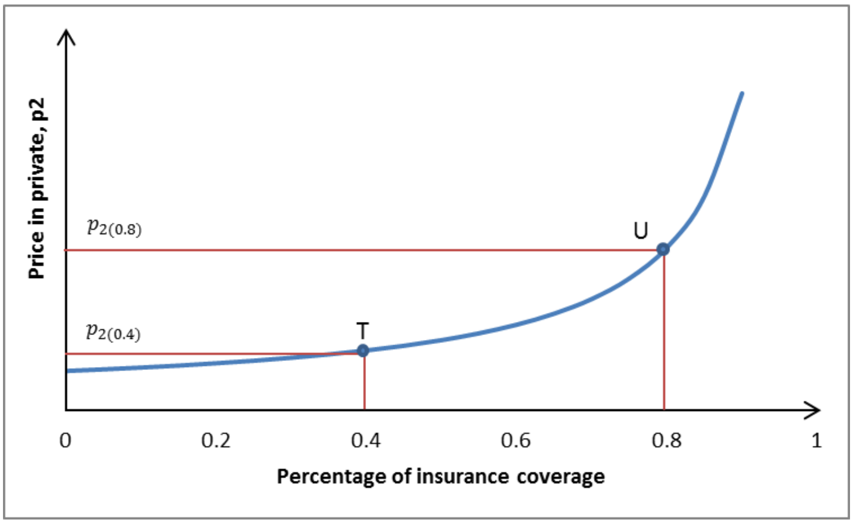


Figure 2. 11 Price in private and percentage of insurance coverage

Based on our findings, we can generalize the result for the quality level when more population are covered with insurance. The quality is going to the same line with the price, as facilities charge higher price, they are providing treatment with higher quality of treatment. Providers will try to maintain the demand level particularly for the population without insurance coverage by offering treatment with high quality so patients might see this offer as the compensation from the higher price level in return. The total welfare might be increasing along with the more population coverage if the patient's benefit and provider's profit are larger than the government transfer to subsidize the insurance. On the other hand, the total welfare might be lower along with the increasing percentage population with insurance if the government transfer to subsidize the insurance exceeds the patient's benefit and provider's benefit put together.

2.8 Discussion

Our research has a purpose in analyzing the effect of dual practice and insurance to price and quality of health care treatment. We analyze these effects by evaluating the long run welfare and short run welfare. The dual practice and insurance are common approach to enhance health care access in developing country. The initial argument on allowing dual practice in health care system is to provide more services available under limited human resource. The insurance existence is a mechanism to ease health access in term of financial capability. This research analyzes the price, quality, and welfare in four situations based on the dual practice regulation and insurance regime: without dual practice-no insurance, without dual practice but with insurance, with dual practice but without insurance, and the last one is with dual practice and insurance in the system.

We provide a table that contains summary of the result regarding price in private sector under four regimes. The Table 2.6 is a comparative statics of variables in the model to the price in private facility, p_2. All variables show consistence sign in four regimes. For example the effect of price in public facility to price of private facility is a positive, as well as the effect of transport cost to price of private facility, and treatment cost to price of private facility. The insurance coverage gives similar direction to the price in private, the higher proportion of treatment fee will be paid by the insurance company then the higher private facility sets its price. The two other components are the cost component of dual practice facility, cost of treatment and cost of quality. They have the same direction as other cost components from private facility. The increasing cost of treatment will increase the price. This is a common reaction for provider in order to maintain the profit level.

Table 2. 6 Summary of sign effect for variables in each situation

Variables	No dual practice No insurance	No dual practice Insurance	Dual practice No insurance	Dual practice Insurance
$\widetilde{p_1}$	+	+	+	+
$\widetilde{q_1}$	-	-	-	-
t	+	+	+	+
c_2	+	+	+	+
φ_2	+/-	+/-	+/-	+/-
s		-		-
c_1			+	+
φ_1			+/-	+/-

Price of private facility under insurance regime in general is higher than under non-insurance regime. While price under dual practice regime will be lower among others. The dual practice regime gives as a consequence that the dual practice facility is a competitor for private facility. Without dual practice, patient in the afternoon working hours can only visit private facility, but after the introduction of dual practice, he can choose between private facility and dual practice facility. In our model the private facility is a private facility with a private physician and dual practice is a private facility with dual practice physician. The patient has more choices of health provider under dual practice existence. The additional competitor splits the demand in the afternoon and price equilibrium in private facility is set to a lower price in order for private facility to maximize its profit level given the presence of an "afternoon" competitor when dual practice is allowed.

In contrast, our model shows that the insurance scheme makes the price in private facility is higher compare to the situation without insurance. We measure the insurance as a percentage of treatment fee that will be covered by insurance company. The insurance component attached on price and cost in the private price equilibrium process. The more insurance covers the treatment fee, the price in private sector will be higher. From demand side, under no dual practice-with insurance regime, all patients visit private facility in the afternoon. Patients with insurance pay less of treatment fee to the health care facility. We describe the relationship between insurance and patient's utility that the treatment fee will reduce the patient's income. Meanwhile from price of private equilibrium mechanism, the insurance component will increase the price in private. The situation describes that under no dual practice with insurance regime, private market is fully a monopolist market with only one player, the private health care provider. The lack of competition and risk sharing by patients make private can sets the price to the higher point. The insurance has the expected effect on the price as appeared in the previous literature. The risk sharing mechanism between the patient and third party where patient gets financial protection and might pay small amount out of pocket makes the private provider responses with the increasing price.

In the afternoon under dual practice regulation, the price competition between dual practice facility and private facility is determined by the price of the public facility set by the government. The price in dual practice facility can be higher or lower than a price in private facility. Both facilities have the same reaction with the increasing of price in public sector. The private sector will increase the price and increase the quality to keep patients coming to the facility. The government has an essential role in the price determination of private sector. Our model proved that the higher the price in the public provider, the private provider positively responses with the increasing price. The public provider usually associated with lower price and lower quality compared to the private provider. The private provider stays in the market by offering treatment with higher quality of treatment. We should note that the increasing quality provided in the facility is followed by the increasing price. The private sector can maintain the marginal profit by balancing number of patients who still interest to the quality offered and patient that decide to leave because of higher price in private facility. Brekke, Nuscheler, and Straume (2006) have shown in their study that the price is necessary to induce quality provision to differentiate between two providers. We should note that their research is in competition framework and use a different approach as ours, such as their model do not use price as competition tools, but quality and treatment specification instead.

The quality of public provider set up by the government also links with the price determination by a private provider. The private provider responds by lowering the price when the government has increased the level of quality in public provider. The private provider tries to attract more patients by lowering the price. The increasing quality in public might attract some patients to divert into public provider rather than choosing the private one. The private provider lowering the price although, in compensation, the lower price means a lower quality of treatment offered by private provider. In this point, the private provider reaction by lowering price is the reasonable way to keep the competition with the public provider. The result on quality has a different direction with the finding in (Kuchinke, Zerth, & Wiese, 2009) when one provider sets a standard quality, another provider should adjust the quality into at least equal to the standard, or they have to leave the market. Our specific finding on quality of private sector shows that quality in public has a negative relationship with the quality in private facility. Our result is based on the construction of the model that the quality depends on the price. The quality in public has an adverse effect on price of private facility; hence it also has a negative relationship with the quality of private.

The increasing of travel cost that faced by the patient will be responded with the increasing price in the private facility. The travel cost in our definition refers to the distance of the patient from the health care provider. The higher travel cost means that the farther the distance of patient from the private facility. This can be translated into the scarcity level of facility and the lack of physician in the system. The private providers then have stronger bargaining power over the price. They can increase the price while people still come to the private facility to get treatment anyway.

The measurement of total welfare consists of welfare of patient in the morning, patient in the afternoon, welfare of private facility, welfare of public facility, insurance company and government transfer. The latter comes from the assumption that the government will pay the insurance part to insurance company, and it will become the reduction factor of total welfare. Welfare of the patient comes from the patient's utility from visiting health care facility to get treatment. Patients have income and pay a treatment price and get the benefit from the treatment quality. The welfare of facility comes from the profit function, where facilities get revenue from price of treatment paid by the patients minus the cost of treatment and cost of quality. The insurance company is set to null because we set the company in break-even condition and we do not involve the insurance company in our timeline decision. The insurance company plays as third party that will receive a transfer from the government and pays the exact amount to health care provider under insurance regime

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The dual practice effect and insurance effect to welfare provide similar indication that both factors might give positive and negative effect depends on parameter values. When it is break down into effect of dual practice per total welfare component, it shows that consumer always get positive impact due to the lower price of private facility under dual practice regime. The private facility gets negative impact, because it is suffered from lowering down the price. The public facility might get benefit or loss under dual practice regime. When less patients come to facility because they are more attracted to low price in private facility, hence the public facility faces loss. But when lesser patients can be covered from the marginal profit, the public facility still gets benefit. The effect of insurance to total welfare by components show that most of them might get positive and negative impact from insurance. Only public facility always gets benefit from insurance regime. More patients might come to public facility, because the price of private facility is getting higher. Public facility will gets higher profit margin from shifting demand of patients to the facility.

Price of the treatment is a primary factor of patient welfare, as patient has to pay the price treatment and it will reduce the income. The increasing of price in public and private will reduce the patient welfare. In contrast, the private facility and public facility, in general, will gain more in term of welfare when the price is increasing. This will directly connect to the demand of treatment in each facility. When the demand of public facility is high, and suppose the cost of treatment is quite low compares to price, the welfare of public provider is high. The demand of private facility or dual practice facility also depends on the demand side. In a particular situation where demand of private facility is low compare to demand of public facility or demand of dual practice facility, the welfare of private facility will be less.

The government transfer measures the money transfer from government to insurance company related to the treatment fee covered by insurance. In our case, we assume that under insurance regime the government has ability to pay the insurance payment for all patients. The insurance company will pay a part of treatment fee to the health care facility. This scenario is also typical in a health care system where government has a significant role in providing health care. In a particular case, the government uses the scenario to subsidize the lowest income population in order to ease people accessing health care. The increasing percentage of insurance part makes the government transfer get bigger and increases the reduction factor of our welfare function, and it makes the loss of total welfare.

Our analysis of welfare for each regime indicates the claim that depending on parameter values, the total welfare under dual practice regime might be higher or lower than the total welfare under insurance regime in the short run and in the long run. One important component of welfare in the long run is the patient's welfare especially patient's welfare in the afternoon. Under dual practice regime, patient pay less in the private sector as the price in private sector is lower compare in the regime without dual practice. From the facility welfare point of view, the lower price in private facility is compensated with, the higher demand of private facility and dual practice facility. When most people will visit private facility, only some of patients still visit public facility and the demand of public facility is low, hence the public facility is having low welfare. The reduction of total welfare from the loss of public facility will be covered from the higher level of welfare in private and dual practice facility. On the other hand, under insurance regime, the demand of public facility is very high, and public facility gets high profit, while the demand of private facility is low in the morning, but in the afternoon all patient will visit private facility. Hence the private facility still gains revenue. Comparing the two total welfares between two regimes will result that dual practice has higher benefit in term of welfare than the insurance regime. The insurance might have better impact to the system in term of welfare in the condition where the demand of public is high and demand of private facility in the morning is low while in the afternoon all patients can only visit the private facility. The total welfare under insurance regime will be still high. In contrast, under dual practice, the demand of public is low, and the public facility is having great loss that affected the total welfare. The loss is so high that cannot be covered with the welfare from private facility. Comparing the total welfare of dual practice or insurance will result that having insurance is a better option compare to having dual practice.

In the short run, the dual practice effect is higher than insurance effect in a condition when under dual practice regime, the demand of public is very high and dual practice is also high while the demand of private is low. The welfare of public facility is high enough to cover the low level of private facility welfare due to the low demand in private facility. Meanwhile, under insurance regime, the demand of public is high and the demand of private is low but the loss in private is so severe that cannot be covered by the welfare from public facility. We also note that having insurance in the system must be supported with the government obligation to pay transfers that reduce the total welfare. The higher the price and demand will cause the larger reduction factor. Hence the total welfare in insurance is lower than total welfare under dual practice. The opposite comparison is when having insurance is a better option compare to having dual practice in term of welfare when under dual practice regime, the demand of public in the morning is really high while the demand of private is very low. The loss in private sector is harming significantly the total welfare under dual practice and cannot be covered from the high welfare of public facility. Meanwhile the demand of public facility under insurance is also high compare to the demand of private facility. The loss in private sector under insurance is still bearable compare to the loss of private sector in dual practice due to the low level of demand in private facility. These benefits still exceeds the government transfer due to insurance. Thus total welfare under insurance is still higher than total welfare of dual practice.

The next chapter of Chapter 3 and Chapter 4 will provide the empirical studies related with dual practice from the demand and supply point of view. In Chapter 3 we discuss on how people choose health care facility with the dual practice existence and we include the variables from our theoretical framework such as price of treatment, quality of treatment, travel cost, and insurance. Chapter 4 specifically discusses the physician as representative of supply side and we include the related variables such as quality and the cost of treatment in the form of physician salary.

2.9 Conclusion

We conclude this chapter by stating our main contribution once again. We construct the patient decision on choosing facility by differentiating the time to seek care for two periods of time: morning and afternoon. We show how private provider reaction on price and quality after knowing the price and quality set by the public provider under the different scheme of dual practice and insurance. We build the model that represents the dual practice situation combine with the insurance scheme in the most developing country setting: the dual practice usually allowed in the system without any strict regulation and the lack of insurance involvement in the population. The paper also provides assessment on which policy gives a better impact in term of short run effect and long run effect. Using a general model that involves variables related we have been able to characterize the equilibrium of price in private facility.

The main conclusion is that, under certain conditions the dual practice existence in the system reduces the price in the private facility. The insurance in the system has an opposite effect with dual practice, where it makes higher price of private sector. The adjusted model on insurance also confirms that more population covered with insurance will make higher level of price in private sector. The main intuition is straightforward. The dual practice means more competitors for the facility. The private sector in the afternoon now consists of the private facility with the different physician, the dual practice and the private one. The patients have choices to a more specific private facility characterized by its physician. In the condition without dual practice, the private facility has higher bargaining power over the patient, especially in the afternoon, because all patient must go to the private therefore private facility can set high price. The insurance effect on the price setting mechanism behaves the same direction as the previous paper has predicted. The private sector sets higher price when there is more certainty that patient can pay the treatment fee. The relation between price and quality shows that the quality of treatment is highly related to the price in a positive way.

The access to health care can be related with two different policy instruments. The first one is through the dual practice, and the other one is through insurance coverage. The dual practice regime creates more competitors in private market and makes private facility lowering its price. Patients will have choices to visit private provider or dual practice provider and not always end up in public facility. The existence of dual practice can be further interpreted that there will be more health care available in the system and more private facilities. The patient will have shorter distance to travel to get health care treatment. The insurance guaranties the patient to pay treatment fee. It creates financial stability, and the patient has more independent choice over the price as he can get treatment without hesitance.

The analysis on welfare effect shows that depending on parameter values, the effect of dual practice and insurance to total welfare might be positive or negative. The total welfare in dual practice might be higher or lower than insurance regime. Our model shows that the main factor that differentiates the welfare level comes from the demand shift between public and private facility in the morning, and between dual practice and private facility in the afternoon if dual practice allowed in the system. In general, the system benefits the most when government is allowing dual practice. The additional competitor keeps the price in private sector lower than the initial case or without insurance. In contrast, adding insurance component in the system is lowered the total welfare due to price effect and government transfer. The insurance causes the price in private to go higher than the initial case although the demand of private facility is still maintained as insured patient will pay less due to insurance coverage.

There are some issues that we have not addressed in this paper. We limit our study on the relation between patient and health care facilities only. The dual practice regulation and insurance coverage is determined at the beginning so public facility has the same price and quality level for each possible regime. Related with the insurance where we left the decision of an individual to involve in the insurance scheme as taken as given and we limited the insurance mechanism as the government is able to pay the percentage of treatment fee as insurance subsidy.

Our analysis is a necessary to link between the health care access policies of dual practice and insurance from theoretical point of view. Ones should note that in this chapter we discuss the theoretical approach on effect of dual practice by using the total welfare to provide appropriate judgment on the ideal case of having or not having dual practice or insurance in the system. The model has adjusted price in equilibrium which represents long term situation and a constant price to represent short term effect. In the next chapter, we will calibrate the theoretical finding with the empirical analysis of the price effect, the patient decision to describe the demand side and the physician decision to represent the supply side regarding dual practice situation.

Appendix

Table 2A.1 Comparison of previous studies in dual practice

AUTHORS	QUESTIONS	ANSWERS	APPROACH
Barros and Martinez-Giralt (2002)	• How do health care providers decide on price and quality in the different market allocations according to the type of insurance contract offered by insurer and different? • How providers decision on different timing: simultaneous decision between prices and qualities for primary care sector, sequential decision (first qualities and then prices) for specialized health care sector.	• Enforcing the fixed-co-payment rule on the primary health care sector is enough to make providers choose the optimal (welfare maximizing) price and quality levels. • In the specialized health care sector, a regulated (public) provider to reach the first-best solution in prices and qualities and implement either the fixed-co-payment or the fixed-reimbursement rules.	Develops model following Hotelling model that combines element of vertical differentiation (quality) and horizontal differentiation (price). Qualities are selected by providers.
Bir and Eggleston (2003)	• What are the costs and benefits from dual practice in health care system ?	• Dual practice may increase or decrease public service quality depends on whether benefit of dual practice attracts highly skilled physicians and other social cost.	Develops model of dual practice incentives. Government explicitly seeks to maintain a given quality of care and minimizing total cost of salaries and total cost of dual practice. The model is specifically mentioning the primary care as the case of the discussion.
Gonzalez (2004)	• How do physicians in the public sector affected by their activities in the private sector? • Analysis in two different regulation of dual practice : exclusive contract	• Physicians have incentives to over provide treatments in public in order to gain reputation in private sector. • In the mechanism where a proper incentive was included	Using principal agent model between physicians, health authority, and patients. The study focused on physicians who build reputation by avoiding under-treatment in public sector in order to

AUTHORS	QUESTIONS	ANSWERS	APPROACH
	for physicians work only in public and limiting private earning	in the contract, it is never optimal for health authority to offer exclusive contract. • In the flat salary mechanism, the exclusive contract for physician may works. • The regulation of limiting physician's earning can use to decrease physician's tendency to over provide treatments.	gain more profit in private practice. The model analyses the relationship between patient, physician, and regulator, hence not differentiate the scope of treatment between primary or secondary care.
Barros and Olivella (2005)	• What is physician's strategic behaviour as dual practitioner concerning waiting list and cream skimming? • Do physicians cream skim the mildest case from the public sector waiting list ?	• Full cream skimming where all mildest patients go to private sector only compatible with intermediate rationing policy. • Partial cream skimming where there are also intermediate cases be treated in private sector happen in the very lax or stringent rationing policy.	Supply side waiting list model concerning patient selection. Positive model as it does not account the effect of patient selection on welfare. Rationing policy is an exogenous variable and the model involves two players: physicians and patients. The study analyse specifically for the hospital care.
Gonzalez (2005)	• How do physician's incentives to influence and manage waiting list to their own private benefit ?	• In the situation where there is agreement to treat some patients on public waiting list in private hospitals, the 'cream skimming' appears. • Physicians select the less severe patients to be treated in private hospitals, thus make the policy maker's main goal to reduce waiting list in public sector cannot achieved.	Model involved three players: health authority, physicians, and patients. The two main assumptions: capacity in public sector is constrained, waiting list exist in public sector but not in private. The framework analyse particularly for the hospital care.
Brekke, Nuscheler, and Straume (2006)	• What is firm strategic interaction between horizontal differentiation	• The result showed that under full commitment, there is overinvestment on quality because of	Using the extended of Hotelling model, firms choose their location and quality.

AUTHORS	QUESTIONS	ANSWERS	APPROACH
	(quality) and vertical differentiation (specialization) under regulated price ? • The interaction is analysed in two versions: full commitment where regulator sets the price prior to location and quality decision, partial commitment where price is set after regulator decides the location and quality.	the optimal (second-best) price. • The horizontal differentiation is insufficient if the transportation cost is high. The optimal price is the first best under partial commitment, but again the horizontal differentiation is high.	
Biglaiser and Ma (2007)	• How does job incentives in moonlighting? • How does the effect of moonlighting on service quality, price, and consumer welfare in public and private sector? • How does government regulation in moonlighting market may enhance consumer's welfare?	• Allowing moonlighting will enhance the aggregate consumer welfare, the equilibrium of public care quality can be increase or decrease. • If the public care quality is increasing, then it will improve each consumer's expected utility. • The price regulation in the private market is suggested to mitigate the negative effect of moonlighting.	Model with three groups of players: a set of consumers and two sets of doctors, dedicated doctors and profit maximizer. In regulated private sector. The model is a general model that can be applied in any field outside health sector. The framework used in this research is applied for the general environment as long as involves mixed economy between public and private sector.
Brekke and Sogard (2007)	• How does private option for public physicians affect their public sector labor supply and public provision of health care ? • What role does competition among physicians play for public and private health care	• Allowing dual physician practice 'crowds out' public provision (reducing effort in public sector) and lower overall health care provision. • In order to decrease the negative effect, the health authority can offer higher wage for physicians.	Adopting the representative consumer approach. Modelling the physician's labor supply that involves three agents: health authority, physicians, and patients. Considering physician as oligopolistic since it competes in Cournot fashion. The research does not mention

AUTHORS	QUESTIONS	ANSWERS	APPROACH
	provision ? • Is mixed health care system always desirable or should health authority ban dual physician practice?	• Banning dual practice can be optimal in the case where physician's competition is weak or treatment between public and private is closely substituted. • When physician's competition is hard, the mixed health care system with dual physician practice should be considered as an optimal system.	specifically on primary care or secondary care but emphasize more on the differentiation between public and private sector.
Delfgaauw (2007)	• How does the system of health care provision affect the allocation of patients to physicians when physicians differ in altruism?	• All patients will get benefit from the system where private care is provided along with free treatment in public sector. • Rich patients get high quality treatment from the private care while the poor ones will get it from dedicated physicians in public sector. • Altruistic physicians will tend to work in public sector because it gives greater impact on patient's welfare. • Transferring patients from public to private practice will reduce the beneficial effect of private provision for the poorest patient.	Model involves patients who differ in income, physicians who differ in altruism and treatment which differ in quality. Compare between purely public health care system and mixed health care system where private sector exist together with public. The model does not empirically say the use for primary or secondary care, but more focuses on the organization affiliated with physician (public or private facility)
Kuchinke, Zerth, & Wiese(2009)	• What is the impact of the standardization on horizontal and vertical quality in a regional health care market? The horizontal quality refers to the location	• In the reference case (no provider acts as a leader standard quality), two providers will differentiate each other using vertical quality. • In the standardization case (one provider acts	The reference case employs the typical Hoteling framework and the extension of Hoteling framework for the standardization case. The expanded model involves two steps. In the first step, providers

AUTHORS	QUESTIONS	ANSWERS	APPROACH
	of the provider and the scope of the medical treatment offered in the facility while the vertical quality is the level of quality treatment.	as a leader), the results are homogeneous supply but the follower might be out from the market because cannot offer standard quality due to higher price. The follower can be stay in the market by offering the equal standard quality with the leader and taking a sub optimal profit.	can choose location, scope of treatment, and quality. In the second step, the model introduces standardization; one provider has already select the level of vertical quality as a standard quality in the market. The model can be applied for the outpatient case and inpatient care for the simplicity shake.
Grassi and Ma (2012)	• How do public supplier react to consumer selection by private firm ? • How does consumer get different surplus from public and private effect the public supply and price in private ? • How do equilibrium change as the information structure change ?	• When rationing based on wealth, there is continuum equilibrium. The public supplier uses the budget on poor consumers while rich consumers get rationed. Price set by private sectors will rise as budget increase because only rich consumers with higher willingness to pay stay in the private market. • When rationing based on wealth and cost information are used as rationing policy, it gives unique equilibrium. The public supplier uses budget for the patients with low cost and ignores consumer’s wealth information. There is cost effectiveness criterion in equilibrium. The public will serve low cost benefit patients and private firms will serve the high ones.	Principal agent model, where public supplier and private are the principals and consumer is the agent. They apply two regime of rationing policy, the first is using wealth and the second is using wealth and cost information. The model is applied for the case where there are public provider and private firm. It does not necessarily the case of health care provider.

AUTHORS	QUESTIONS	ANSWERS	APPROACH
Gonzalez and Stadler (2013)	• How do the three interventions deal with physicians dual practice? • Which regulation does suit with developing countries?	• In case of limiting policy, limiting physician's earning is worse than limiting physician's involvement in dual practice. • In developed countries, policy on dual practice depends on cost of dual practice. In low cost of dual practice, there is no intervention needed, while in larger cost, the best intervention is limiting physician's involvement in dual practice. Banning policy is never be the optimal choice. • In developing countries, the attractiveness of private sector play important rule. In the high level of private attractiveness, it is never worth to intervene dual practice. In the low attractiveness, the optimal policy is limitation. The exclusive contract is never optimal in developing countries.	A two stages model with health authority and a set of physician. The health authority will choose the regulation and physicians differ by ability. There are two health production factors to reflect variations among countries. For developed countries, the production of health depends on the entire physicians and not by individual characters. In developing countries, the production health depends heavily on the physician's characteristics. The research considers the heterogeneity resources, such as different characteristics of health care system and different specialties physician (primary physician and specialist).
Kuhn and Nuscheler (2013)	• How does dual practice work in the setting where basic treatment provided for free in public facilities while the intensive treatment provided out of pocket in private? • Does dual practice will generate an	• The Physicians shift waiting cost to public patients in order to increase the willingness to pay for private treatment. • Waiting time turns to be socially optimal, the over provision of private care happens if and only if the waiting	Performing first and second best allocation. The setting involves monopolistic physician and patient who differ in benefit from the treatment as a way to explore patient's heterogeneity. Waiting time plays role in the model. The oversupply

AUTHORS	QUESTIONS	ANSWERS	APPROACH
	excessive or sufficient supply of private care? • Is Dual practice sociallly valuable or whether it should be disallowed?	cost is sufficiently high. • In the second best allocation, health authority chooses physician reimbursement in the public segment without any control to private provision. Banning dual practice may improve in the second best allocation, but it depends on the welfare weight the health authority attaches to physician profit.	and under supply will depend on the financial aspect and time cost. Physician can self-refer the patients from public sector to private. The background of the framework is for the secondary care.

2A The Solution for Price and Quality of private in each regime (p_2, q_2)

2A. 1 The Solution for price of private provider in regime of no dual practice-no insurance in the system $(p_2{}^{\mathrm{NN}})$

The profit function of private facility under no dual practice-no insurance regime is:

$$\pi_{pv}{}^{NN} = D^{morning}(p_2{}^{NN}, \widetilde{p_1}, q_2{}^{NN}, \widetilde{q_1})(p_2{}^{NN} - c_2) + D^{afternoon}(p_2{}^{NN}, q_2{}^{NN})(p_2{}^{NN} - c_2) - \varphi_2 \frac{q_2{}^{NN}}{2} \quad \textbf{(A. 1)}$$

Inserting the demand of private facility in the morning and in the afternoon, the profit function becomes:

$$\pi_{pv}{}^{NN} = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} - p_2{}^{NN}}{2t}(p_2{}^{NN} - c_2) + 1.(p_2{}^{NN} - c_2) - \varphi_2 \frac{q_2{}^{NN^2}}{2} \quad \textbf{(A. 2)}$$

The profit function can also be written as follows:

$$\pi_{pv}{}^{NN} = \left(\frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} - p_2{}^{NN}}{2t}\right)p_2 - \left(\frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} - p_2{}^{NN}}{2t}\right)c_2 + p_2 - c_2 - \varphi_2 \frac{q_2{}^{NN^2}}{2} \quad \textbf{(A. 3)}$$

The first order condition of profit function to price is equal to zero, $\frac{\pi_{pv}{}^{NN}}{\partial p_2{}^{NN}} = 0$,

$$\frac{\partial \pi_{pv}{}^{NN}}{\partial p_2{}^{NN}} = -\frac{p_2{}^{NN}}{2t} + \left(\frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} - p_2{}^{NN}}{2t}\right) + \frac{c_2}{2t} + 1 = 0 \qquad \textbf{(A. 4)}$$

Rewrite the above equation into:

$$\frac{\partial \pi_{pv}{}^{NN}}{\partial p_2{}^{NN}} = \frac{-p_2{}^{NN} + t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} - p_2{}^{NN} + c_2 + 2t}{2t} = 0$$

$$= \frac{3t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} - 2p_2{}^{NN} + c_2}{2t} = 0$$

The $p_2{}^{\mathrm{NN}}$ is equal to,

$$2p_2{}^{NN} = 3t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} + c_2 \qquad \textbf{(A. 5)}$$

Or can be written as:

$$p_2{}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NN} + c_2}{2} \qquad \textbf{(A. 6)}$$

Solving the first order condition of profit function to quality equal to 0; $\frac{\partial \pi_{pv}{}^{NN}}{\partial q_2{}^{NN}} = 0$

$$\frac{\partial \pi_{pv}{}^{NN}}{\partial q_2{}^{NN}} = \frac{p_2{}^{NN}}{2t} - \frac{c_2}{2t} - \varphi_2 . q_2 = 0 \qquad \textbf{(A. 7)}$$

$$\varphi_2 . q_2{}^{NN} = \frac{p_2{}^{NN} - c_2}{2t}$$

The $q_2{}^{NN}$ will be equal with

$$q_2{}^{NN} = \frac{p_2{}^{NN} - c_2}{2\varphi_2 t} \qquad \textbf{(A. 8)}$$

We replace ${q_2}^{NN}$ in the ${p_2}^{NN} = \frac{3t-\widetilde{q_1}+\widetilde{p_1}+{q_2}^{NN}+c_2}{2}$, with ${q_2}^{NN} = \frac{{p_2}^{NN}-c_2}{2\varphi_2 t}$,

$$ {p_2}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} + \left(\frac{{p_2}^{NN} - c_2}{2\varphi_2 t}\right) + c_2}{2} \qquad \textbf{(A. 9)} $$

Regrouping the ${p_2}^{NN}$ to the left side becomes:

$$ {p_2}^{NN} - \frac{{p_2}^{NN}}{4\varphi_2 t} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} - \left(\frac{c_2}{2\varphi_2 t}\right) + c_2}{2} $$

And simplified to get:

$$ \left(1 - \frac{1}{4\varphi_2 t}\right) {p_2}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{2\varphi_2 t}\right) c_2}{2} $$

The final solution of price in private facility under no dual practice-no insurance regime is:

$$ {p_2}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{2\varphi_2 t}\right) c_2}{2\left(1 - \frac{1}{4\varphi_2 t}\right)} \qquad \textbf{(A. 10)} $$

2A.2 The solution for quality of private provider in the case of no dual practice-no insurance in the system (${q_2}^{NN}$)

We replace the ${p_2}^{NN}$ ${q_2}^{NN} = \frac{{p_2}^{NN}-c_2}{2\varphi_2 t}$ using the final solution of ${p_2}^{NN} = \frac{3t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{2\varphi_2 t}\right)c_2}{2\left(1-\frac{1}{4\varphi_2 t}\right)}$ and get

$$q_2{}^{NN} = \frac{\left(\dfrac{3t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{2\varphi_2 t}\right) c_2}{2\left(1 - \frac{1}{4\varphi_2 t}\right)}\right) - c_2}{2\varphi_2 t} \quad \textbf{(A. 11)}$$

The solution for $q_2{}^{NN}$ is:

$$q_2{}^{NN} = \frac{3t - \widetilde{q_1} + \widetilde{p_1} - c_2}{4\varphi_2 t - 1} \quad \textbf{(A. 12)}$$

2A.3 Solution of price in private provider in the regime of no dual practice-with insurance in the system ($p_2{}^{\mathrm{NI}}$)

The profit function of the private facility is defined as:

$$\pi_{pv}{}^{NI} = D^{morning}(p_2{}^{\mathrm{NI}}, \widetilde{p_1}, q_2{}^{NI}, \widetilde{q_1})(p_2{}^{\mathrm{NI}} - c_2) + D^{afternoon}(p_2{}^{\mathrm{NI}}, q_2{}^{NI})(p_2{}^{\mathrm{NI}} - c_2) - \varphi_2 \frac{q_2{}^{NI^2}}{2} \quad \textbf{(A. 13)}$$

Putting the demand function in the profit function and becomes:

$$\pi_{pv}{}^{NI} = \frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} - sp_2{}^{\mathrm{NI}}}{2t}(p_2{}^{\mathrm{NI}} - c_2) + 1.(p_2{}^{\mathrm{NI}} - c_2) - \varphi_2 \frac{q_2{}^{NI^2}}{2} \quad \textbf{(A. 14)}$$

Expanding the equation above becomes:

$$\pi_{pv}{}^{NI} = \left(\frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} - sp_2{}^{\mathrm{NI}}}{2t}\right) p_2{}^{\mathrm{NI}}$$

$$- \left(\frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} - sp_2{}^{\mathrm{NI}}}{2t}\right) c_2 + (p_2{}^{\mathrm{NI}} - c_2)$$

$$- \varphi_2 \frac{q_2{}^{NI^2}}{2} \qquad \textbf{(A. 15)}$$

Finding the first order condition equal to zero, $\frac{\partial \pi_{pv}{}^{NI}}{\partial p_2{}^{\mathrm{NI}}} = 0$,

$$\frac{\partial \pi_{pv}{}^{NI}}{\partial p_2{}^{\mathrm{NI}}} = -\frac{sp_2{}^{\mathrm{NI}}}{2t} + \left(\frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} - sp_2{}^{\mathrm{NI}}}{2t}\right) + \frac{sc_2}{2t} + 1 = 0 \qquad \textbf{(A. 16)}$$

The result is simplified into:

$$\frac{\partial \pi_{pv}{}^{NI}}{\partial p_2{}^{\mathrm{NI}}} = \frac{-sp_2 + t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} - sp_2{}^{\mathrm{NI}} + sc_2 + 2t}{2t}$$

$$= \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} - 2sp_2{}^{\mathrm{NI}} + cs_2}{2t} = 0 \qquad \textbf{(A. 17)}$$

Bringing the $p_2{}^{\mathrm{NI}}$ to the left side:

$$2sp_2{}^{\mathrm{NI}} = 3t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{NI} + c_2$$

Then dividing both sides with 2:

$$p_2{}^{\mathrm{NI}} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} + sc_2}{2s}$$

Finding first order condition of profit function on quality of private facility equal to 0, $\frac{\partial \pi_{pv}{}^{NI}}{q_2{}^{NI}} = 0$

$$\frac{\partial \pi_{pv}{}^{NI}}{q_2{}^{NI}} = \frac{p_2{}^{\mathrm{NI}}}{2t} - \frac{c_2}{2t} - \varphi_2 . q_2{}^{NI} = 0 \qquad \textbf{(A. 18)}$$

Bringing the $q_2{}^{NI}$ to the left side of equal sign:

$$\varphi_2 . q_2{}^{NI} = \frac{p_2{}^{\mathrm{NI}} - c_2}{2t}$$

The $q_2{}^{NI}$ becomes:

$$q_2{}^{NI} = \frac{p_2{}^{\mathrm{NI}} - c_2}{2\varphi_2 t} \qquad \textbf{(A. 19)}$$

We replace q_2 in the $p_2{}^{\mathrm{NI}} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{NI} + sc_2}{2s}$, with $q_2{}^{NI} = \frac{p_2{}^{\mathrm{NI}} - c_2}{2\varphi_2 t}$:

$$p_2{}^{\mathrm{NI}} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + \frac{p_2{}^{\mathrm{NI}} - c_2}{2\varphi_2 t} + sc_2}{2s} \qquad \textbf{(A. 20)}$$

Grouping the $p_2{}^{\mathrm{NI}}$ into the left side:

$$p_2{}^{\mathrm{NI}} - \frac{p_2{}^{\mathrm{NI}}}{4s\varphi_2 t} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} - \left(\frac{c_2}{2\varphi_2 t}\right) + sc_2}{2s}$$

The equation above is simplified:

$$\left(1 - \frac{1}{4s\varphi_2 t}\right) p_2{}^{\mathrm{NI}} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{2\varphi_2 t}\right) c_2}{2s}$$

The final solution for the price in private facility under no dual practice- insurance regime is:

$$p_2{}^{\mathrm{NI}} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{2\varphi_2 t}\right) c_2}{2\left(s - \frac{1}{4\varphi_2 t}\right)} \quad \textbf{(A. 21)}$$

2A.4 The Solution of quality in private provider in the case of no dual practice - with insurance in the system ($q_2{}^{NI}$)

We replace the final solution of $p_2{}^{\mathrm{NI}}$ in the $q_2{}^{NI} = \frac{p_2{}^{\mathrm{NI}} - c_2}{2\varphi_2 t}$ with

$p_2{}^{\mathrm{NI}} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{2\varphi_2 t}\right) c_2}{2\left(s - \frac{1}{4\varphi_2 t}\right)}$:

$$q_2{}^{NI} = \frac{\left(\frac{3t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{2\varphi_2 t}\right) c_2}{2s\left(1 - \frac{1}{4s\varphi_2 t}\right)}\right) - c_2}{2\varphi_2 t} \quad \textbf{(A. 22)}$$

The final solution for the quality of the private facility under no dual practice-insurance regime is:

$$q_2{}^{NI} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} - sc_2}{4s\varphi_2 t - 1} \quad \textbf{(A. 23)}$$

2A.5 The solution for price in private provider in the case of with dual practice - without insurance in the system ($p_2{}^{DN}$)

The profit function of private facility is:

$$\pi_{pv}{}^{DN} = D^{morning}(p_2{}^{DN}, \widetilde{p_1}, q_2{}^{DN}, \widetilde{q_1})(p_2{}^{DN} - c_2) + D^{afternoon}(p_2{}^{DN}, p_1{}^{DN}, q_2{}^{DN}, q_1{}^{DN})(p_2{}^{DN} - c_2) - \varphi_2 \frac{q_2{}^{DN^2}}{2} \quad \textbf{(A. 24)}$$

Replacing the demand of health care in each part will get,

$$\pi_{pv}{}^{DN} = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DN} - p_2{}^{DN}}{2t}(p_2{}^{DN} - c_2) + \frac{t - q_1{}^{DN} + p_1{}^{DN} + q_2{}^{DN} - p_2{}^{DN}}{2t}(p_2{}^{DN} - c_2) - \varphi_2 \frac{q_2{}^{DN^2}}{2} \quad \textbf{(A. 25)}$$

And simplify into:

$$\pi_{pv}{}^{DN} = \left(\frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DN} - p_2{}^{DN}}{2t}\right)p_2 - \left(\frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DN} - p_2{}^{DN}}{2t}\right)c_2 + \left(\frac{t - q_1{}^{DN} + p_1{}^{DN} + q_2{}^{DN} - p_2{}^{DN}}{2t}\right)p_2 - \left(\frac{t - q_1{}^{DN} + p_1{}^{DN} + q_2{}^{DN} - p_2{}^{DN}}{2t}\right)c_2 - \varphi_2 \frac{q_2{}^{DN^2}}{2} \quad \textbf{(A. 26)}$$

The first order condition of profit function on price is equal to 0, $\frac{\partial \pi_{pv}{}^{DN}}{\partial p_2{}^{DN}} = 0$,

$$\frac{\partial \pi_{pv}{}^{DN}}{\partial p_2{}^{DN}}$$

$$= -\frac{p_2{}^{DN}}{2t} + \left(\frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DN} - p_2{}^{DN}}{2t}\right)$$

$$+ \frac{c_2}{2t} - \frac{p_2{}^{DN}}{2t}$$

$$+ \left(\frac{t - q_1{}^{DN} + p_1{}^{DN} + q_2{}^{DN} - p_2{}^{DN}}{2t}\right) + \frac{c_2}{2t}$$

$$= 0 \qquad \textbf{(A. 27)}$$

The price of private facility is then:

$$p_2{}^{DN} = \frac{2t - \widetilde{q_1} + \widetilde{p_1} + 2q_2 + 2c_2 - q_1{}^{DN} + p_1{}^{DN}}{4} \qquad \textbf{(A. 28)}$$

The first order condition of profit function on quality is equal to 0, $\frac{\partial \pi_{pv}{}^{DN}}{\partial q_2{}^{DN}} = 0$,

$$\frac{\partial \pi_{pv}{}^{DN}}{\partial q_2{}^{DN}} = \frac{p_2{}^{DN}}{2t} - \frac{c_2}{2t} - \varphi_2 . q_2 + \frac{p_2{}^{DN}}{2t} - \frac{c_2}{2t} = 0 \qquad \textbf{(A. 29)}$$

The quality of private facility is:

$$q_2{}^{DN} = \frac{p_2{}^{DN} - c_2}{\varphi_2 t} \qquad \textbf{(A. 30)}$$

The profit in private-dual practice that consists of afternoon demand only,

$$\pi_{pv(DP)}{}^{DN} = D^{afternoon}(p_2{}^{DN}, p_1{}^{DN}, q_2{}^{DN}, q_1{}^{DN})(p_1{}^{DN} - c_2)$$

$$- \varphi_2 \frac{{q_1{}^{DN}}^2}{2} \qquad \textbf{(A. 31)}$$

The profit function with the demand function is:

$$\pi_{pv(DP)}{}^{DN} = \frac{t + q_1{}^{DN} - p_1{}^{DN} - q_2{}^{DN} + p_2{}^{DN}}{2t}(p_1{}^{DN} - c_1)$$

$$- \varphi_1 \frac{q_1{}^{DN^2}}{2}$$

$$\pi_{pv(DP)}{}^{DN} = \left(\frac{t + q_1{}^{DN} - p_1{}^{DN} - q_2{}^{DN} + p_2{}^{DN}}{2t}\right) p_1{}^{DN}$$

$$- \left(\frac{t + q_1{}^{DN} - p_1{}^{DN} - q_2{}^{DN} + p_2{}^{DN}}{2t}\right) c_1$$

$$- \varphi_1 \frac{q_1{}^2}{2} \qquad \textbf{(A. 32)}$$

The first order condition for the profit of dual practice on its price is equal to zero, $\frac{\partial \pi_{pv(DP)}{}^{DN}}{\partial p_1{}^{DN}} = 0$:

$$\frac{\partial \pi_{pv(DP)}{}^{DN}}{\partial p_1{}^{DN}}$$

$$= -\frac{p_1{}^{DN}}{2t} + \left(\frac{t + q_1{}^{DN} - p_1{}^{DN} - q_2{}^{DN} + p_2{}^{DN}}{2t}\right)$$

$$+ \frac{c_1}{2t} = 0 \qquad \textbf{(A. 33)}$$

The price in dual practice facility is:

$$p_1{}^{DN} = \frac{t - q_1{}^{DN} - q_2{}^{DN} + c_1 + p_2{}^{DN}}{2} \qquad \textbf{(A. 34)}$$

The first order condition for the profit of dual practice on its quality is equal to zero, $\frac{\partial \pi_{pv(DP)}{}^{DN}}{\partial q_1{}^{DN}} = 0$,

$$\frac{\partial \pi_{pv(DP)}{}^{DN}}{\partial q_1{}^{DN}} = \frac{p_1{}^{DN}}{2t} - \frac{c_1}{2t} - q_1{}^{DN}\varphi_1 = 0 \qquad \textbf{(A. 35)}$$

The quality of dual practice facility is given by:

$$q_1{}^{DN} = \frac{p_1{}^{DN} - c_1}{2\varphi_1 t} \qquad \textbf{(A. 36)}$$

We replace $q_1{}^{DN}$ and $q_2{}^{DN}$ in the $p_2{}^{DN} = \frac{2t - \widetilde{q_1} + \widetilde{p_1} + 2q_2 + 2c_2 - q_1{}^{DN} + p_1{}^{DN}}{4}$ using $q_1{}^{DN} = \frac{p_1{}^{DN} - c_1}{2\varphi_1 t}$ and $q_2{}^{DN} = \frac{p_2{}^{DN} - c_2}{\varphi_2 t}$

$$p_2{}^{DN} = \frac{2t - \widetilde{q_1} + \widetilde{p_1} + 2\left(\frac{p_2{}^{DN} - c_2}{\varphi_2 t}\right) + 2c_2 - \left(\frac{p_1{}^{DN} - c_1}{2\varphi_1 t}\right) + p_1{}^{DN}}{4} \qquad \textbf{(A. 37)}$$

Grouping the $p_2{}^{DN}$ to the left side is;

$$4p_2 - \frac{2p_2{}^{DN}}{\varphi_2 t} = 2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right)2c_2 - \frac{c_1}{2\varphi_1 t} + \left(1 - \frac{1}{2\varphi_1 t}\right)p_1{}^{DN}$$

And get the ${p_2}^{DN}$ as:

$$
{p_2}^{DN} = \frac{2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right) 2c_2 - \frac{c_1}{2\varphi_1 t} + \left(1 - \frac{1}{2\varphi_1 t}\right) {p_1}^{DN}}{2\left(2 - \frac{1}{\varphi_2 t}\right)} \quad \textbf{(A. 38)}
$$

The ${p_2}^{DN}$ solution still contain unsolved component of p_1, which represent the price in dual practice facility. We put the abbreviation of DN to differentiate the regime (dual practice-with insurance), so we will solve the ${p_1}^{DN}$. We replace ${q_1}^{DN}$ and ${q_2}^{DN}$ in the ${p_1}^{DN} = \frac{t - {q_1}^{DN} - {q_2}^{DN} + c_1 + {p_2}^{DN}}{2}$ using ${q_1}^{DN} = \frac{{p_1}^{DN} - c_1}{2\varphi_1 t}$ and ${q_2}^{DN} = \frac{{p_2}^{DN} - c_2}{\varphi_2 t}$:

$$
{p_1}^{DN} = \frac{t - \frac{{p_1}^{DN} - c_1}{2\varphi_1 t} - \frac{{p_2}^{DN} - c_2}{\varphi_2 t} + c_1 + {p_2}^{DN}}{2} \quad \textbf{(A. 39)}
$$

Grouping the ${p_1}^{DN}$ into one side of the equation is:

$$
2{p_1}^{DN} - \frac{{p_1}^{DN}}{2\varphi_1 t} = t - \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 - \frac{c_2}{\varphi_2 t} + \left(1 - \frac{1}{\varphi_2 t}\right) {p_2}^{DN}
$$

The ${p_1}^{DN}$ is then:

$$
{p_1}^{DN} = \frac{t - \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 - \frac{c_2}{\varphi_2 t} + \left(1 - \frac{1}{\varphi_2 t}\right) {p_2}^{DN}}{\left(2 - \frac{1}{2\varphi_1 t}\right)} \quad \textbf{(A. 40)}
$$

We substitute the p_1^{DN} in $p_2^{DN} = \frac{2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(1-\frac{1}{2\varphi_1 t}\right)p_1^{DN}}{2\left(2-\frac{1}{\varphi_2 t}\right)}$ using $p_1^{DN} = \frac{t-\left(1-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}+\left(1-\frac{1}{\varphi_2 t}\right)p_2^{DN}}{\left(2-\frac{1}{2\varphi_1 t}\right)}$;

$$p_2^{DN} = \frac{2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(1-\frac{1}{2\varphi_1 t}\right)\frac{t-\left(1-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}+\left(1-\frac{1}{\varphi_2 t}\right)p_2^{DN}}{\left(2-\frac{1}{2\varphi_1 t}\right)}}{2\left(2-\frac{1}{\varphi_2 t}\right)}$$

(A. 41)

Regrouping the p_2^{DN} into the left side of the equal sign:

$$\left(1-\frac{\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)}{\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)}\right)p_2^{DN}$$

$$= \frac{2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(1-\frac{1}{2\varphi_1 t}\right)\frac{t-\left(1-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}}{\left(2-\frac{1}{2\varphi_1 t}\right)}}{2\left(2-\frac{1}{\varphi_2 t}\right)}$$

The solution of the price in private facility under dual practice-no insurance regime is:

$$p_2^{DN} = \frac{\left(2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2+\frac{c_1}{2\varphi_1 t}\right)\left(2-\frac{1}{2\varphi_1 t}\right)+\left(t+\left(1-\frac{1}{2\varphi_1 t}\right)c_1+\frac{c_2}{\varphi_2 t}\right)\left(1-\frac{1}{2\varphi_1 t}\right)}{\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)}$$

(A. 42)

The final solution of equilibrium price in private facility with dual practice physician, $p_1{}^{DN}$ is obtained by substituting $p_2{}^{DN}$ in $p_1{}^{DN} = \frac{t-\left(1-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}+\left(1-\frac{1}{\varphi_2 t}\right)p_2{}^{DN}}{\left(2-\frac{1}{2\varphi_1 t}\right)}$ using $p_2{}^{DN} = \frac{2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(1-\frac{1}{2\varphi_1 t}\right)p_1{}^{DN}}{2\left(2-\frac{1}{\varphi_2 t}\right)}$:

$$p_1{}^{DN} = \frac{t-\left(1-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}+\left(1-\frac{1}{\varphi_2 t}\right)\frac{2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(1-\frac{1}{2\varphi_1 t}\right)p_1{}^{DN}}{2\left(2-\frac{1}{\varphi_2 t}\right)}}{\left(2-\frac{1}{2\varphi_1 t}\right)} \quad \textbf{(A. 43)}$$

Regrouping the $p_1{}^{DN}$ into the left side of equal sign:

$$p_1{}^{DN} - \frac{\left(1-\frac{1}{\varphi_2 t}\right)\frac{\left(1-\frac{1}{2\varphi_1 t}\right)p_1{}^{DN}}{2\left(2-\frac{1}{\varphi_2 t}\right)}}{\left(2-\frac{1}{2\varphi_1 t}\right)} = \frac{t-\left(1-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}+\left(1-\frac{1}{\varphi_2 t}\right)\frac{2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}}{2\left(2-\frac{1}{\varphi_2 t}\right)}}{\left(2-\frac{1}{2\varphi_1 t}\right)}$$

The final solution for the $p_1{}^{DN}$ is:

$$p_1{}^{DN} == \frac{\left(2t-\widetilde{q_1}+\widetilde{p_1}\left(1-\frac{1}{\varphi_2 t}\right)2c_2+\frac{c_1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)+\left(t+\left(1-\frac{1}{2\varphi_1 t}\right)c_1+\frac{c_2}{\varphi_2 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)}{\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)}$$

(A. 44)

2A.6 The Solution of quality in private provider in the case of with dual practice but without insurance in the system ($q_2{}^{DN}$)

We replace the p_2^{DN} in the $q_2^{DN} = \frac{p_2^{DN} - c_2}{\varphi_2 t}$ with the final solution of p_2^{DN} and we get,

$$q_2^{DN} = \frac{\dfrac{\left(2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t}\right)}{\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)}}{\varphi_2 t}$$

(A. 45)

The final solution for the quality in private is:

$$q_2^{DN} = \frac{\left(2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t}\right)\left(1 - \frac{1}{2\varphi_1 t}\right)}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]\varphi_2 t} - \frac{c_2\left(\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right)}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]\varphi_2 t}$$

(A. 46)

2A.7 The solution of price in private provider in the case of with dual practice and with insurance in the system (p_2^{DI})

The profit function in private facility is defined as:

$$
\begin{aligned}
\mathrm{\pi_{pv}}^{\mathrm{DI}} = \mathrm{D^{morning}}(\mathrm{p_2}^{\mathrm{DI}}, \widetilde{\mathrm{p_1}}, \mathrm{q_2}^{\mathrm{DI}}, \widetilde{\mathrm{q_1}})(\mathrm{p_2}^{\mathrm{DI}} - \mathrm{c_2}) \\
+ \mathrm{D^{afternoon}}(\mathrm{p_2}^{\mathrm{DI}}, \mathrm{p_1}^{\mathrm{DI}}, \mathrm{q_2}^{\mathrm{DI}}, \mathrm{q_1}^{\mathrm{DI}})(\mathrm{p_2}^{\mathrm{DI}} - \mathrm{c_2}) \\
- \varphi_2 \frac{{\mathrm{q_2}^{\mathrm{DI}}}^2}{2}
\end{aligned}
\tag{A. 47}
$$

We put the demand function into profit function to get:

$$
\begin{aligned}
\pi_{pv}{}^{DI} = \left(\frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{DI} - sp_2{}^{DI}}{2t}\right) p_2{}^{DI} \\
- \left(\frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{DI} - sp_2{}^{DI}}{2t}\right) c_2 \\
+ \left(\frac{t - q_1{}^{DI} + sp_1{}^{DI} + q_2{}^{DI} - sp_2{}^{DI}}{2t}\right) p_2{}^{DI} \\
- \left(\frac{t - q_1{}^{DI} + sp_1{}^{DI} + q_2{}^{DI} - sp_2{}^{DI}}{2t}\right) c_2 - \varphi_2 \frac{{q_2{}^{DI}}^2}{2}
\end{aligned}
\tag{A. 48}
$$

The first order condition of profit function on price of private facility, $\frac{\partial \pi_{pv}{}^{DI}}{\partial p_2{}^{DI}} = 0$,

$$
\begin{aligned}
\frac{\partial \pi_{pv}{}^{DI}}{\partial p_2{}^{DI}} = -\frac{sp_2{}^{DI}}{2t} + \left(\frac{t - \widetilde{q_1} + s\widetilde{p_1} + q_2{}^{DI} - sp_2{}^{DI}}{2t}\right) + \frac{sc_2}{2t} \\
-\frac{sp_2{}^{DI}}{2t} + \left(\frac{t - q_1{}^{DI} + sp_1{}^{DI} + q_2{}^{DI} - sp_2{}^{DI}}{2t}\right) \\
+ \frac{sc_2}{2t} = 0
\end{aligned}
\tag{A. 49}
$$

The price in private facility is:

$$p_2{}^{DI} = \frac{2t - \widetilde{q_1} + s\widetilde{p_1} + 2q_2{}^{DI} + 2sc_2 - q_1{}^{DI} + sp_1{}^{DI}}{4s} \qquad \textbf{(A. 50)}$$

The first order condition of profit function on the quality, $\frac{\partial \pi_{pv}{}^{DI}}{\partial q_2{}^{DI}} = 0,$

$$\frac{\partial \pi_{pv}{}^{DI}}{\partial q_2{}^{DI}} = \frac{p_2{}^{DI}}{2t} - \frac{c_2}{2t} - \varphi_2 . q_2{}^{DI} + \frac{p_2{}^{DI}}{2t} - \frac{c_2}{2t} = 0 \qquad \textbf{(A. 51)}$$

The quality in private facility is:

$$q_2{}^{DI} = \frac{p_2{}^{DI} - c_2}{\varphi_2 t} \qquad \textbf{(A. 52)}$$

The profit in dual practice facility that consists of afternoon demand only,

$$\pi_{pv(DP)}{}^{DI} = D^{afternoon}(p_2{}^{DI}, p_1{}^{DI}, q_2{}^{DI}, q_1{}^{DI})(p_1{}^{DI} - c_2) - \varphi_2 \frac{q_1{}^{DI^2}}{2} \qquad \textbf{(A. 53)}$$

Rewriting the profit function after putting the demand function,

$$\pi_{pv(DP)}{}^{DI} = \frac{t + q_1{}^{DI} - sp_1{}^{DI} - q_2{}^{DI} + sp_2{}^{DI}}{2t}(p_1{}^{DI} - c_1) - \varphi_1 \frac{q_1{}^{DI^2}}{2}$$

$$\pi_{pv(DP)}{}^{DI} = \left(\frac{t + q_1{}^{DI} - sp_1{}^{DI} - q_2{}^{DI} + sp_2{}^{DI}}{2t}\right) p_1 - \left(\frac{t + q_1{}^{DI} - sp_1{}^{DI} - q_2{}^{DI} + sp_2{}^{DI}}{2t}\right) c_1 - \varphi_1 \frac{q_1{}^2}{2} \quad \textbf{(A. 54)}$$

We solve the first order condition, $\frac{\partial \pi_{pv(DP)}{}^{DI}}{\partial p_1{}^{DI}} = 0,$

$$\frac{\partial \pi_{pv(DP)}{}^{DI}}{\partial p_1{}^{DI}} = = -\frac{sp_1}{2t} + \left(\frac{t + q_1{}^{DI} - sp_1{}^{DI} - q_2{}^{DI} + sp_2{}^{DI}}{2t}\right) + \frac{sc_1}{2t} = 0 \quad \textbf{(A. 55)}$$

And get the price of dual practice facility is:

$$p_1{}^{DI} = \frac{t - q_1{}^{DI} - q_2{}^{DI} + sc_1 + sp_2{}^{DI}}{2s} \quad \textbf{(A. 56)}$$

We also solve the first order condition on quality is, $\frac{\partial \pi_{pv(DP)}{}^{DI}}{\partial q_1{}^{DI}} = 0,$

$$\frac{\partial \pi_{pv(DP)}{}^{DI}}{\partial q_1{}^{DI}} = \frac{p_1{}^{DI}}{2t} - \frac{c_1}{2t} - q_1{}^{DI} \varphi_1 = 0 \quad \textbf{(A. 57)}$$

And get the quality in dual practice facility,

$$q_1{}^{DI} = \frac{p_1{}^{DI} - c_1}{2\varphi_1 t} \quad \textbf{(A. 58)}$$

We replace q_1 and q_2 in the $p_2{}^{DI} = \frac{2t-\widetilde{q_1}+s\widetilde{p_1}+2q_2{}^{DI}+2sc_2-q_1{}^{DI}+sp_1{}^{DI}}{4s}$ using $q_1{}^{DI} = \frac{p_1{}^{DI}-c_1}{2\varphi_1 t}$ and $q_2{}^{DI} = \frac{p_2{}^{DI}-c_2}{\varphi_2 t}$:

$$p_2{}^{DI} = \frac{2t - \widetilde{q_1} + s\widetilde{p_1} + 2\frac{p_2{}^{DI} - c_2}{\varphi_2 t} + 2sc_2 - \frac{p_1{}^{DI} - c_1}{2\varphi_1 t} + sp_1{}^{DI}}{4s} \quad \textbf{(A. 59)}$$

Grouping the $p_2{}^{DI}$ to the left side:

$$4sp_2{}^{DI} - \frac{2p_2{}^{DI}}{\varphi_2 t} = 2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right)2c_2 - \frac{c_1}{2\varphi_1 t} + \left(s1 - \frac{1}{2\varphi_1 t}\right)p_1$$

The price in private quality becomes:

$$p_2{}^{DI} = \frac{2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right)2c_2 - \frac{c_1}{2\varphi_1 t} + \left(s - \frac{1}{2\varphi_1 t}\right)p_1{}^{DI}}{2\left(2s - \frac{1}{\varphi_2 t}\right)} \quad \textbf{(A. 60)}$$

We replace $q_1{}^{DI}$ and $q_2{}^{DI}$ in the $p_1{}^{DI} = \frac{t-q_1{}^{DI}-q_2{}^{DI}+sc_1+sp_2{}^{DI}}{2s}$ using $q_1{}^{DI} = \frac{p_1{}^{DI}-c_1}{2\varphi_1 t}$ and $q_2{}^{DI} = \frac{p_2{}^{DI}-c_2}{\varphi_2 t}$:

$$p_1{}^{DI} = \frac{t - \frac{p_1{}^{DI} - c_1}{2\varphi_1 t} - \frac{p_2{}^{DI} - c_2}{\varphi_2 t}\frac{p_2{}^{DI} - c_2}{\varphi_2 t} + sc_1 + sp_2{}^{DI}}{2s} \qquad \textbf{(A. 61)}$$

Grouping the $p_1{}^{DI}$ into the same side:

$$2sp_1{}^{DI} - \frac{p_1{}^{DI}}{2\varphi_1 t} = t - \left(s - \frac{1}{2\varphi_1 t}\right) c_1 - \frac{c_2}{\varphi_2 t} + \left(s - \frac{1}{\varphi_2 t}\right) p_2{}^{DI}$$

The price in dual practice facility is:

$$p_1{}^{DI} = \frac{t - \left(s - \frac{1}{2\varphi_1 t}\right) c_1 - \frac{c_2}{\varphi_2 t} + \left(s - \frac{1}{\varphi_2 t}\right) p_2{}^{DI}}{\left(2s - \frac{1}{2\varphi_1 t}\right)} \qquad \textbf{(A. 62)}$$

We substitute the $p_1{}^{DI}$ in the $p_2{}^{DI} = \frac{2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 - \frac{c_1}{2\varphi_1 t} + \left(s - \frac{1}{2\varphi_1 t}\right) p_1{}^{DI}}{2\left(2s - \frac{1}{\varphi_2 t}\right)}$ using $p_1{}^{DI} = \frac{t - \left(s - \frac{1}{2\varphi_1 t}\right) c_1 - \frac{c_2}{\varphi_2 t} + \left(s - \frac{1}{\varphi_2 t}\right) p_2{}^{DI}}{\left(2s - \frac{1}{2\varphi_1 t}\right)}$:

$$p_2{}^{DI} = \frac{2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 - \frac{c_1}{2\varphi_1 t} + \left(s - \frac{1}{2\varphi_1 t}\right) \frac{t - \left(s - \frac{1}{2\varphi_1 t}\right) c_1 - \frac{c_2}{\varphi_2 t} + \left(s - \frac{1}{\varphi_2 t}\right) p_2{}^{DI}}{\left(2s - \frac{1}{2\varphi_1 t}\right)}}{2\left(2s - \frac{1}{\varphi_2 t}\right)} \qquad \textbf{(A. 63)}$$

Grouping the $p_2{}^{DI}$ into the left side:

$$\left(1-\frac{\left(s-\frac{1}{2\varphi_1 t}\right)\left(s-\frac{1}{\varphi_2 t}\right)}{\left(2s-\frac{1}{2\varphi_1 t}\right)2\left(2s-\frac{1}{\varphi_2 t}\right)}\right){p_2}^{DI}$$

$$=\frac{2t-\widetilde{q_1}+s\widetilde{p_1}+\left(s-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(s-\frac{1}{2\varphi_1 t}\right)\frac{t-\left(s-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}}{\left(2s-\frac{1}{2\varphi_1 t}\right)}}{2\left(2s-\frac{1}{\varphi_2 t}\right)}$$

The final solution for the price of private facility is:

$${p_2}^{DI}=\frac{\left(2t-\widetilde{q_1}+s\widetilde{p_1}+\left(s-\frac{1}{\varphi_2 t}\right)2c_2+\frac{c_1}{2\varphi_1 t}\right)\left(2s-\frac{1}{2\varphi_1 t}\right)+\left(t+\left(s-\frac{1}{2\varphi_1 t}\right)c_1+\frac{c_2}{\varphi_2 t}\right)\left(s-\frac{1}{2\varphi_1 t}\right)}{\left(2s-\frac{1}{2\varphi_1 t}\right)2\left(2s-\frac{1}{\varphi_2 t}\right)-\left(s-\frac{1}{2\varphi_1 t}\right)\left(s-\frac{1}{\varphi_2 t}\right)} \quad \textbf{(A. 64)}$$

The final solution of equilibrium price in dual practice facility, ${p_1}^{DI}$ is obtained by substituting ${p_2}^{DI}$ in ${p_1}^{DI}=\frac{t-\left(s-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}+\left(s-\frac{1}{\varphi_2 t}\right){p_2}^{DI}}{\left(2s-\frac{1}{2\varphi_1 t}\right)}$ using ${p_2}^{DI}=\frac{2t-\widetilde{q_1}+s\widetilde{p_1}+\left(s-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(s-\frac{1}{2\varphi_1 t}\right){p_1}^{DI}}{2\left(2s-\frac{1}{\varphi_2 t}\right)}$.

$${p_1}^{DI}=\frac{t-\left(s-\frac{1}{2\varphi_1 t}\right)c_1-\frac{c_2}{\varphi_2 t}+\left(s-\frac{1}{\varphi_2 t}\right)\frac{2t-\widetilde{q_1}+s\widetilde{p_1}+\left(s-\frac{1}{\varphi_2 t}\right)2c_2-\frac{c_1}{2\varphi_1 t}+\left(s-\frac{1}{2\varphi_1 t}\right){p_1}^{DI}}{2\left(2s-\frac{1}{\varphi_2 t}\right)}}{\left(2s-\frac{1}{2\varphi_1 t}\right)} \quad \textbf{(A. 65)}$$

Grouping the ${p_1}^{DI}$ into the left side:

$$p_1{}^{DI} - \frac{\left(s - \frac{1}{\varphi_2 t}\right) \frac{\left(s - \frac{1}{2\varphi_1 t}\right) p_1{}^{DI}}{2\left(2s - \frac{1}{\varphi_2 t}\right)}}{\left(2s - \frac{1}{2\varphi_1 t}\right)}$$

$$= \frac{t - \left(s - \frac{1}{2\varphi_1 t}\right) c_1 - \frac{c_2}{\varphi_2 t} + \left(s - \frac{1}{\varphi_2 t}\right) \frac{2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 - \frac{c_1}{2\varphi_1 t}}{2\left(2s - \frac{1}{\varphi_2 t}\right)}}{\left(2s - \frac{1}{2\varphi_1 t}\right)}$$

The final solution of price in dual practice facility is:

$$p_1{}^{DI} = \frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right)}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)} \qquad \textbf{(A. 66)}$$

2A.8 The solution of quality in private provider in the case of with dual practice and with insurance in the system ($q_2{}^{DI}$)

We replace the p_2 in $q_2 = \frac{p_2{}^{DI} - c_2}{\varphi_2 t}$ using final solution of $p_2{}^{DI}$,

$$q_2{}^{DI} = \frac{\frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t}\right)\left(s - \frac{1}{2\varphi_1 t}\right)}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)} - c_2}{\varphi_2 t} \qquad \textbf{(A. 67)}$$

The final solution for the quality in private facility is:

$$
{q_2}^{DI} = \frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right)2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right)c_1 + \frac{c_2}{\varphi_2 t}\right)\left(s - \frac{1}{2\varphi_1 t}\right)}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]\varphi_2 t}
$$

$$
- \frac{c_2\left(\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right)}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]\varphi_2 t}
$$

(A. 68)

2B Comparative static for each case

2B.1 The comparative static for the case of no dual practice and no insurance (NN)

The second order conditions:

$$
\frac{\partial^2 \pi_{pv}^{NN}}{\partial {p_2^{NN}}^2} = -\frac{1}{2t} - \frac{1}{2t} = -\frac{2}{2t} = -\frac{1}{t} \tag{B. 1}
$$

$$
\frac{\partial^2 \pi_{pv}^{NN}}{\partial {p_2^{NN}}^2} = -\varphi_2 \tag{B. 2}
$$

$$
\frac{\partial {\pi_{pv}}^2}{\partial p_2^{NN} \partial q_2^{NN}} = \frac{1}{2t} \tag{B. 3}
$$

$$
\frac{\partial {\pi_{pv}}^2}{\partial p_2^{NN} \partial q_2^{NN}} = \frac{1}{2t} \tag{B. 4}
$$

$$\begin{vmatrix} -\frac{1}{t} & \frac{1}{2t} \\ \frac{1}{2t} & -\varphi_2 \end{vmatrix} = \left(-\frac{1}{t}\right)(-\varphi_2) - \left(\frac{1}{2t}\right)\left(\frac{1}{2t}\right) = \frac{\varphi_2}{t} - \frac{1}{(2t)^2} \tag{B. 5}$$

$$\frac{\varphi_2}{t}\left(1 - \frac{1}{4\varphi_2 t}\right) > 0 \tag{B. 6}$$

The condition is true for $\varphi_2 > 0, t > 0$.

The comparative statics for the price of public facility:

$$\frac{\partial p_2^{NN}}{\partial \widetilde{p_1}} = \frac{1}{2\left(1 - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{NN}}{\partial \widetilde{p_1}} > 0 \tag{B. 7}$$

The comparative statics of quality $\widetilde{q_1}$ is

$$\frac{\partial p_2^{NN}}{\partial \widetilde{q_1}} = -\frac{1}{2\left(1 - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{NN}}{\partial \widetilde{q_1}} < 0 \tag{B. 8}$$

The comparative statics of travel cost:

$$\frac{\partial p_2^{NN}}{\partial t}$$

$$= \frac{\left(3+\frac{c_2}{2\varphi_2 t^2}\right)2\left(1-\frac{1}{4\varphi_2 t}\right)-\left(3t-\widetilde{q_1}+\widetilde{p_1}+(1-\frac{1}{2\varphi_2 t})c_2\right)\left(\frac{1}{2\varphi_2}\right.}{\left(2\left(1-\frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2^{NN}}{\partial t} > 0$$

(B. 9)

The comparative statics for quality of treatment:

$$\frac{\partial p_2^{NN}}{\partial c_2} = \frac{\left(1-\frac{1}{2\varphi_2 t}\right)}{2\left(1-\frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{NN}}{\partial c_2} > 0$$

(B. 10)

The comparative statics for cost of quality:

$$\frac{\partial p_2^{NN}}{\partial \varphi_2}$$

$$= \frac{\left(\frac{c_2}{2{\varphi_2}^2 t}\right)2\left(1-\frac{1}{4\varphi_2 t}\right)-\left(3t-\widetilde{q_1}+\widetilde{p_1}+(1-\frac{1}{2\varphi_2 t})c_2\right)\left(\frac{1}{4{\varphi_2}^2 t}\right.}{\left(2\left(1-\frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2^{NN}}{\partial \varphi_2} <> 0$$

(B. 11)

2B.2 The case of no dual practice but with insurance (NI)

The second order conditions:

$$\frac{\partial^2 \pi_{pv}^{NI}}{\partial p_2^{NI^2}} = -\frac{s}{2t} - \frac{s}{2t} = -\frac{2s}{2t} = -\frac{s}{t} \tag{B. 12}$$

$$\frac{\partial^2 \pi_{pv}^{NI}}{\partial q_2^{NI^2}} = -\varphi_2 \tag{B. 13}$$

$$\frac{\partial^2 \pi_{pv}^{NI}}{\partial p_2^{NI} \partial q_2^{NI}} = \frac{1}{2t} \tag{B. 14}$$

$$\begin{vmatrix} -\frac{s}{t} & \frac{1}{2t} \\ \frac{1}{2t} & -\varphi_2 \end{vmatrix} = \left(-\frac{s}{t}\right)(-\varphi_2) - \left(\frac{1}{2t}\right)\left(\frac{1}{2t}\right) = \frac{\varphi_2 s}{t} - \frac{1}{(2t)^2} \tag{B. 15}$$

$$\frac{\varphi_2}{t}\left(s - \frac{1}{4\varphi_2 t}\right) > 0 \tag{B. 16}$$

The result must hold the conditions of $\varphi_2 > 0, t > 0, 0 < s \leq 1$.

The comparative statics for the price of public facility:

$$\frac{\partial p_2^{NI}}{\partial \widetilde{p_1}} = \frac{s}{2\left(s - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{NI}}{\partial \widetilde{p_1}} > 0 \tag{B. 17}$$

The comparative statics of quality $\widetilde{q_1}$ is

$$\frac{\partial p_2^{NI}}{\partial \widetilde{q_1}} = -\frac{1}{2\left(s - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{NI}}{\partial \widetilde{p_1}} < 0 \qquad \textbf{(B. 18)}$$

The comparative statics of travel cost:

$$\frac{\partial p_2^{NI}}{\partial t}$$

$$= \frac{\left(3 + \frac{c_2}{2\varphi_2 t^2}\right) 2\left(s - \frac{1}{4\varphi_2 t}\right) - \left(3t - \widetilde{q_1} + s\widetilde{p_1} + (s - \frac{1}{2\varphi_2 t})c_2\right)\left(\frac{}{2\varphi}\right.}{\left(2\left(s - \frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2^{NI}}{\partial t} > 0 \qquad \textbf{(B. 19)}$$

The comparative statics for quality of treatment:

$$\frac{\partial p_2^{NI}}{\partial c_2} = \frac{\left(s - \frac{1}{2\varphi_2 t}\right)}{2\left(1 - \frac{1}{4\varphi_2 t}\right)}$$

$$\frac{\partial p_2}{\partial c_2} > 0 \qquad \textbf{(B. 20)}$$

The comparative statics for cost of quality:

$$\frac{\partial p_2^{NI}}{\partial \varphi_2}$$

$$= \frac{\left(\frac{c_2}{2{\varphi_2}^2 t}\right) 2\left(s - \frac{1}{4\varphi_2 t}\right) - \left(3t - \widetilde{q_1} + s\widetilde{p_1} + (s - \frac{1}{2\varphi_2 t}) c_2\right)\left(\frac{1}{2{\varphi_2}^2 t}\right)}{\left(2\left(1 - \frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2}{\partial \varphi_2} <> 0 \qquad \textbf{(B. 21)}$$

The comparative statics for insurance:

$$\frac{\partial p_2^{NI}}{\partial s}$$

$$= \frac{(\widetilde{p_1} + c_2) 2\left(s - \frac{1}{4\varphi_2 t}\right) - 2\left(3t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{2\varphi_2 t}\right) c_2\right)}{\left(2\left(s - \frac{1}{4\varphi_2 t}\right)\right)^2}$$

$$\frac{\partial p_2^{NI}}{\partial s} < 0 \qquad \textbf{(B. 22)}$$

2B.3 The case of dual practice but no insurance (DN)

The second order conditions are following:

$$\frac{\partial^2 \pi_{pv}^{DN}}{\partial {p_2^{DN}}^2} = -\frac{1}{2t} - \frac{1}{2t} - \frac{1}{2t} - \frac{1}{2t} = -\frac{4}{2t} \qquad \textbf{(B. 23)}$$

$$\frac{\partial^2 \pi_{pv}^{DN}}{\partial {q_2^{DN}}^2} = -\varphi_2 \qquad \textbf{(B. 24)}$$

$$\frac{\partial^2 \pi_{pv}^{DN}}{\partial p_2^{DN} \partial q_2^{DN}} = \frac{1}{2t} + \frac{1}{2t} = \frac{2}{2t} = \frac{1}{t} \qquad \textbf{(B. 25)}$$

$$\begin{vmatrix} -\frac{4}{2t} & \frac{1}{t} \\ \frac{1}{t} & -\varphi_2 \end{vmatrix} = -\frac{4}{2t}.-\varphi_2 - \frac{1}{t}.\frac{1}{t} = \frac{4\varphi_2}{2t} - \frac{1}{t^2} \qquad \textbf{(B. 26)}$$

$$\frac{\varphi_2}{t}\left(2 - \frac{1}{\varphi_2 t}\right) > 0 \qquad \textbf{(B. 27)}$$

$$\frac{\partial^2 \pi_{DP}^{DN}}{\partial {p_1^{DN}}^2} = -\frac{1}{2t} - \frac{1}{2t} = -\frac{2}{2t} = -\frac{1}{t} \qquad \textbf{(B. 28)}$$

$$\frac{\partial^2 \pi_{pv}^{DN}}{\partial {q_1^{DN}}^2} = -\varphi_1 \qquad \textbf{(B. 29)}$$

$$\frac{\partial^2 \pi_{DP}^{DN}}{\partial p_1^{DN} \partial q_1^{DN}} = \frac{1}{2t} \qquad \textbf{(B. 30)}$$

$$\begin{vmatrix} -\frac{1}{t} & \frac{1}{2t} \\ \frac{1}{2t} & -\varphi_1 \end{vmatrix} = -\frac{1}{t}.-\varphi_1 - \frac{1}{2t}.\frac{1}{2t} \qquad \textbf{(B. 31)}$$

$$\frac{\varphi_1}{2t}\left(2 - \frac{1}{2\varphi_1 t}\right) > 0 \qquad \textbf{(B. 32)}$$

The comparative statics for price in public:

$$\frac{\partial p_2^{DN}}{\partial \widetilde{p_1}} = \frac{\left(2 - \frac{1}{2\varphi_1 t}\right)}{\left(2 - \frac{1}{2\varphi_1 t}\right) 2 \left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)} \qquad \textbf{(B. 33)}$$

$$\frac{\partial p_2^{DN}}{\partial \widetilde{p_1}} > 0$$

Based on the second order conditions where,

$$\frac{\varphi_1}{2t}\left(2 - \frac{1}{2\varphi_1 t}\right) > 0$$

Hence $\varphi_1 > 0, \varphi_2 > 0, t > 0,$

$\left(2 - \frac{1}{\varphi_2 t}\right) > 0,$

$\left(2 - \frac{1}{2\varphi_1 t}\right) > 0,$

$\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) > \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right),$

$\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right) > \left(2 - \frac{1}{2\varphi_1 t}\right).$

Then we have $\frac{\partial p_2^{DN}}{\partial \widetilde{p_1}} > 0$.

The comparative statics for quality of public facility:

$$\frac{\partial p_2^{DN}}{\partial \widetilde{q_1}} = -\frac{\left(2 - \frac{1}{2\varphi_1 t}\right)}{\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{DN}}{\partial \widetilde{q_1}} < 0 \qquad \textbf{(B. 34)}$$

The comparative statics for travel cost:

$$\frac{\partial p_2^{DN}}{\partial t}$$

$$= \frac{\left(2+\frac{2c_2}{\varphi_2 t^2}-\frac{c_1}{2\varphi_1 t^2}\right)\left(2-\frac{1}{2\varphi_1 t}\right)+\left(2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2+\frac{c_1}{2\varphi_1 t}\right)\left(\frac{c_1}{2\varphi_1 t^2}\right)}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^3}$$

$$+ \frac{\left(1+\frac{c_1}{2\varphi_1 t^2}-\frac{2c_2}{\varphi_2 t^2}\right)\left(1-\frac{1}{2\varphi_1 t}\right)+\left(t+c_1-\frac{c_1}{2\varphi_1 t}+\frac{c_2}{\varphi_2 t}\right)\left(\frac{1}{2\varphi_1 t}\right)}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^3}$$

$$- \frac{\left[\left(2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2+\frac{c_1}{2\varphi_1 t}\right)\left(\frac{c_1}{2\varphi_1 t^2}\right)\left(2-\frac{1}{2\varphi_1 t}\right)+\left(t+\left(1-\frac{1}{2\varphi_1 t}\right)c_1+\frac{c_2}{\varphi_2 t}\right)\left(1-\frac{1}{2\varphi_1 t}\right)\right]}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left[\left(\frac{1}{2\varphi_1 t^2}\right)\left(4-\frac{2}{\varphi_2 t}\right)+\left(2-\frac{1}{2\varphi_1 t}\right)\left(\frac{1}{\varphi_2 t}\right)-\left(\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)+\left(1-\frac{1}{2\varphi_1 t}\right)\left(\frac{1}{\varphi_2 t^2}\right)\right]}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\frac{\partial p_2^{DN}}{\partial t} > 0 \qquad \textbf{(B. 35)}$$

The comparative statics for the cost of treatment:

$$\frac{\partial p_2^{DN}}{\partial c_2} = \frac{4-2\left(\frac{1}{2\varphi_1 t}\right)-3\left(\frac{1}{\varphi_2 t}\right)+\left(\frac{1}{2\varphi_1 t}\right)\left(\frac{1}{\varphi_2 t}\right)}{7+3\left(\frac{1}{2\varphi_1 t}\right)-3\left(\frac{1}{\varphi_2 t}\right)+\left(\frac{1}{2\varphi_1 t}\right)\left(\frac{1}{\varphi_2 t}\right)} \qquad \textbf{(B. 36)}$$

$$\frac{\partial p_2^{DN}}{\partial c_2} >$$

The comparative statics for cost of quality treatment in private facility:

$$\frac{\partial p_2^{DN}}{\partial \varphi_2}$$

$$= \frac{\left[\left(\frac{2c_2}{\varphi_2{}^2 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(-\frac{c_2}{\varphi_2{}^2 t}\right)\left(1 - \frac{2}{2\varphi_1 t}\right)\right]\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right.\right.}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$- \frac{\left[\left(2t - \widetilde{q_1} + \widetilde{p_1} + \left(1 - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(1 - \frac{1}{2\varphi_1 t}\right) c_1 + \frac{c_2}{\varphi_2 t}\right)\left(1 - \frac{1}{2\varphi_1 t}\right)\right.}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left[\left(2 - \frac{1}{2\varphi_1 t}\right)\left(\frac{2}{\varphi_2{}^2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(\frac{1}{\varphi_2{}^2 t}\right)\right]}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\frac{\partial p_2^{DN}}{\partial \varphi_2} <> 0 \qquad \textbf{(B. 37)}$$

The comparative statics for cost of treatment in dual facility,

$$\frac{\partial p_2^{DN}}{\partial c_1} = \frac{\left[\left(\frac{1}{2\varphi_1 t}\right)\left(2 - \frac{1}{2\varphi_1 t}\right) + \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]}{\left[\left(2 - \frac{1}{2\varphi_1 t}\right) 2\left(2 - \frac{1}{\varphi_2 t}\right) - \left(1 - \frac{1}{2\varphi_1 t}\right)\left(1 - \frac{1}{\varphi_2 t}\right)\right]}$$

$$\frac{\partial p_2^{DN}}{\partial c_1} < 0 \qquad \textbf{(B. 38)}$$

The comparative statics for cost of quality treatment in dual practice facility,

$$\frac{\partial p_2^{DN}}{\partial \varphi_1}$$

$$= \frac{\left(\frac{c_1}{2{\varphi_1}^2 t}\right)\left(2-\frac{1}{\varphi_1 t}\right)+\left(2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2+\frac{c_1}{2\varphi_1 t}\right)\left(\frac{1}{{\varphi_1}^2 t}\right)}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^3}$$

$$+ \frac{\left(1+\frac{c_1}{{\varphi_1}^2 t}\right)\left(1-\frac{1}{2\varphi_1 t}\right)+\left(t+\left(1-\frac{1}{2\varphi_1 t}\right)c_1+\frac{c_2}{\varphi_2 t}\right)\left(\frac{1}{2{\varphi_1}^2 t}\right)}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^3}$$

$$- \frac{\left[\left(2t-\widetilde{q_1}+\widetilde{p_1}+\left(1-\frac{1}{\varphi_2 t}\right)2c_2+\frac{c_1}{2\varphi_1 t}\right)\left(2-\frac{1}{2\varphi_1 t}\right)+\left(t+\left(1-\frac{1}{2\varphi_1 t}\right)c_1+\frac{c_2}{\varphi_2 t}\right)\left(1-\frac{1}{2\varphi_1 t}\right)\right.}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left[\left(\frac{1}{2{\varphi_1}^2 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(\frac{1}{2{\varphi_1}^2 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]}{\left[\left(2-\frac{1}{2\varphi_1 t}\right)2\left(2-\frac{1}{\varphi_2 t}\right)-\left(1-\frac{1}{2\varphi_1 t}\right)\left(1-\frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\frac{\partial p_2^{DN}}{\partial \varphi_1} <> 0 \qquad \textbf{(B. 39)}$$

2B.4 The case of dual practice-insurance (DI)

The second order conditions are following:

$$\frac{\partial^2 \pi_{pv}^{DI}}{\partial {p_2^{DI}}^2} = -\frac{s}{2t}-\frac{s}{2t}-\frac{s}{2t}-\frac{s}{2t} = -\frac{4s}{2t} \qquad \textbf{(B. 40)}$$

$$\frac{\partial^2 \pi_{pv}^{DI}}{\partial {q_2^{DI}}^2} = -\varphi_2 \qquad \textbf{(B. 41)}$$

$$\frac{\partial^2 \pi_{pv}^{DI}}{\partial p_2^{DI}\partial q_2^{DI}} = \frac{1}{2t}+\frac{1}{2t} = \frac{2}{2t} = \frac{1}{t} \qquad \textbf{(B. 42)}$$

$$\begin{vmatrix} -\frac{4s}{2t} & \frac{1}{t} \\ \frac{1}{t} & -\varphi_2 \end{vmatrix} = -\frac{4s}{2t}.-\varphi_2 - \frac{1}{t}.\frac{1}{t} = \frac{4s\varphi_2}{2t} - \frac{1}{t^2} \qquad \textbf{(B. 43)}$$

$$\frac{2\varphi_2}{t}\left(2s - \frac{1}{\varphi_2 t}\right) > 0 \qquad \textbf{(B. 44)}$$

$$\frac{\partial^2 \pi_{pv}^{DI}}{\partial {p_1^{DI}}^2} = -\frac{s}{2t} - \frac{s}{2t} = -\frac{2s}{2t} = -\frac{s}{t} \qquad \textbf{(B. 45)}$$

$$\frac{\partial^2 \pi_{pv}^{DI}}{\partial {q_1^{DI}}^2} = -\varphi_1 \qquad \textbf{(B. 46)}$$

$$\frac{\partial^2 \pi_{pv}^{DI}}{\partial p_2 \partial q_2} = \frac{1}{2t} \qquad \textbf{(B. 47)}$$

$$\begin{vmatrix} -\frac{s}{t} & \frac{1}{2t} \\ \frac{1}{2t} & -\varphi_1 \end{vmatrix} = -\frac{s}{t}.-\varphi_1 - \frac{1}{2t}.\frac{1}{2t} = \frac{s\varphi_1}{t} - \frac{1}{4t^2} \qquad \textbf{(B. 48)}$$

$$\frac{\varphi_1}{2t}\left(2s - \frac{1}{2\varphi_1 t}\right) > 0 \qquad \textbf{(B. 49)}$$

The comparative statics of price in public, $\widetilde{p_1}$,

$$\frac{\partial p_2^{DI}}{\partial \widetilde{p_1}} = \frac{s\left(2s - \frac{1}{2\varphi_1 t}\right)}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)} \qquad \textbf{(B. 50)}$$

$$\frac{\partial p_2^{DI}}{\partial \widetilde{p_1}} > 0$$

The comparative statics of quality in public:

$$\frac{\partial p_2^{DI}}{\partial \widetilde{q_1}} = -\frac{\left(2s - \frac{1}{2\varphi_1 t}\right)}{\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{DI}}{\partial \widetilde{q_1}} < 0 \qquad \textbf{(B. 51)}$$

The comparative statics of travel cost:

$$\frac{\partial p_2^{DI}}{\partial t}$$

$$= \frac{\left[\left(-\frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right) 2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left[\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$- \frac{\left[\left(\frac{1}{2{\varphi_1}^2 t}\right)\left(2\left(2s - \frac{1}{\varphi_2 t}\right)\right) - \left(\frac{1}{2{\varphi_1}^2 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left[\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right) 2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\frac{\partial p_2^{DI}}{\partial t} > 0 \tag{B. 52}$$

The comparative statics of insurance:

$$\frac{\partial p_2^{DI}}{\partial s}$$

$$= \frac{\left[(\widetilde{p_1} + 2c_2)\left(2s - \frac{1}{2\varphi_1 t}\right) + 2\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right)2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + c_1\left(s - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right)c_1 + \frac{c_2}{\varphi_2 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$- \frac{\left[2\left(4s - \frac{2}{\varphi_2 t}\right) + 4\left(2s - \frac{1}{2\varphi_1 t}\right) - \left(s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right)2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(t + \left(s - \frac{1}{2\varphi_1 t}\right)c_1 + \frac{c_2}{\varphi_2 t}\right)\left(s - \frac{1}{2\varphi_1 t}\right)}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\frac{\partial p_2^{DI}}{\partial s} > 0 \tag{B. 53}$$

The comparative statics of quality cost:

$$\frac{\partial p_2^{DI}}{\partial \varphi_2}$$

$$= \frac{\left[\left(\frac{2c_2}{{\varphi_2}^2 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \left(-\frac{c_2}{{\varphi_2}^2 t}\right)\left(s - \frac{1}{2\varphi_1 t}\right)\right]\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$- \frac{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)\left(\frac{2}{{\varphi_2}^2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(\frac{1}{{\varphi_2}^2 t}\right)\right]\left[\left(2t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{\varphi_2 t}\right)2c_2 + \frac{c_1}{2\varphi_1 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right)\right]}{\left[\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\frac{\partial p_2^{DI}}{\partial \varphi_2} <> 0 \tag{B. 54}$$

The comparative statics for cost of treatment:

$$\frac{\partial p_2^{DI}}{\partial c_2} = \frac{\left(2s - \frac{2}{\varphi_2 t}\right)\left(2s - \frac{1}{2\varphi_1 t}\right) + \frac{1}{\varphi_2 t}\left(s - \frac{1}{2\varphi_1 t}\right)}{\left(2s - \frac{1}{2\varphi_1 t}\right)2\left(2s - \frac{1}{\varphi_2 t}\right) - \left(s - \frac{1}{2\varphi_1 t}\right)\left(s - \frac{1}{\varphi_2 t}\right)}$$

$$\frac{\partial p_2^{DI}}{\partial c_2} > 0 \tag{B. 55}$$

2C The policy implication

2C.1 The solution of price in private facility in the adjusted model

The profit function of private facility in the adjusted model is

$$\pi_{pv} = \beta(Demand\ of\ s = 0) + (1 - \beta)(Demand\ of\ 1 > s > 0)$$

$$\begin{aligned}\pi_{pv} = \beta&\left[D_{s=0}^{morning}(p_2, \widetilde{p_1}, q_2, \widetilde{q_1})(p_2 - c_2)\right]\\ &+ \left[D_{s=0}^{afternoon}(p_2, p_1, q_2, q_1)(p_2 - c_2)\right]\\ &+ (1-\beta)\left[D_{s=1}^{morning}(p_2, \widetilde{p_1}, q_2, \widetilde{q_1})(p_2 - c_2)\right]\\ &+ (1-\beta)\left[D_{s=1}^{afternoon}(p_2, p_1, q_2, q_1)(p_2 - c_2)\right] - \varphi_2 \frac{{q_2}^2}{2}\end{aligned}$$

$$\begin{aligned}\pi_{pv} = \beta&\left[\left(\frac{t - \widetilde{q_1} + q_2}{2t}\right)(p_2 - c_2)\right] + \left[\left(\frac{t - q_1 + q_2}{2t}\right)(p_2 - c_2)\right]\\ &+ (1-\beta)\left[\left(\frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2 - p_2}{2t}\right)(p_2 - c_2)\right]\\ &+ (1-\beta)\left[\left(\frac{t - q_1 + p_1 + q_2 - p_2}{2t}\right)(p_2 - c_2)\right]\\ &- \varphi_2 \frac{{q_2}^2}{2}\end{aligned} \tag{C. 1}$$

We find the price and quality equilibrium by setting $\frac{\partial \pi_{pv}}{\partial p_2} = 0, \frac{\partial \pi_{pv}}{\partial q_2} = 0.$

$$\frac{\partial \pi_{pv}}{\partial p_2} = \beta\left(\frac{t-\widetilde{q_1}+q_2}{2t}\right) + \beta\left(\frac{t-q_1+q_2}{2t}\right) - \frac{(1-\beta)p_2}{2t}$$

$$+ (1-\beta)\left(\frac{t-\widetilde{q_1}+\widetilde{p_1}+q_2-p_2}{2t}\right) + \frac{(1-\beta)c_2}{2t} - \frac{(1-\beta)p_2}{2t}$$

$$+ (1-\beta)\left(\frac{t-q_1+p_1+q_2-p_2}{2t}\right) + \frac{(1-\beta)c_2}{2t} = 0$$

$$\frac{4p_2}{2t} - \frac{4\beta}{2t} = \frac{t-\widetilde{q_1}+\widetilde{p_1}-\beta\widetilde{p_1}+2q_2-q_1+2c_2-2\beta c_2+p_1-\beta p_1}{2t}$$

$$p_2 = \frac{2t-\widetilde{q_1}+(1-\beta)\widetilde{p_1}+2q_2+2(1-\beta)c_2-q_1+(1-\beta)p_1}{4(1-\beta)} \qquad \textbf{(C. 2)}$$

$$\frac{\partial \pi_{pv}}{\partial q_2} = \frac{\beta p_2}{2t} - \frac{\beta c_2}{2t} - \varphi_2 q_2 + \frac{\beta p_2}{2t} - \frac{\beta c_2}{2t} + \frac{(1-\beta)p_2}{2t} - \frac{(1-\beta)c_2}{2t} + \frac{(1-\beta)p_2}{2t}$$

$$- \frac{(1-\beta)c_2}{2t} = 0$$

$$\frac{2(p_2-c_2)}{2t} = \varphi_2 t$$

$$q_2 = \frac{p_2-c_2}{\varphi_2 t} \qquad \textbf{(C. 3)}$$

The profit function on dual practice facility is

$$\pi_{pv(DP)} = \beta(Demand\ of\ s=0) + (1-\beta)(Demand\ of\ 1>s>0)$$

$$\pi_{pv(DP)}$$

$$= \beta\left[D_{s=0}^{afternoon}(p_2,p_1,q_2,q_1)(p_2-c_2)\right]$$

$$+ (1-\beta)\left[D_{s=1}^{afternoon}(p_2,p_1,q_2,q_1)(p_2-c_2)\right] - \varphi_2\frac{{q_2}^2}{2}$$

$$\pi_{pv(DP)}$$

$$= \beta\left[\left(\frac{t-q_1+q_2}{2t}\right)(p_2-c_2)\right]$$

$$+(1-\beta)\left[\left(\frac{t+q_1-p_1-q_2+p_2}{2t}\right)(p_2-c_2)\right]$$

$$-\varphi_2\frac{{q_2}^2}{2} \qquad \textbf{(C. 4)}$$

We find the equilibrium of p_1 and q_1 by setting $\frac{\partial\pi_{pv(DP)}}{\partial p_1}=0, \frac{\partial\pi_{pv(DP)}}{\partial q_1}=0$:

$$\frac{\partial\pi_{pv(DP)}}{\partial p_1}=0$$

$$\frac{\partial\pi_{pv(DP)}}{\partial p_1}=\beta\left(\frac{t-q_1+q_2}{2t}\right)-\frac{(1-\beta)p_1}{2t}+(1-\beta)\left(\frac{t+q_1-p_1-q_2+p_2}{2t}\right)$$

$$+\frac{(1-\beta)c_1}{2t}=0$$

$$\frac{2p_1}{2t}-\frac{2\beta}{2t}=\frac{t+q_1-q_2+p_2-\beta p_2+c_{1_1}-c_1\beta}{2t}$$

$$p_1=\frac{t-q_1-q_2+(1-\beta)c_1+(1-\beta)p_2}{2(1-\beta)} \qquad \textbf{(C. 5)}$$

$$\frac{\partial\pi_{pv(DP)}}{\partial q_1}=\frac{\beta p_1}{2t}-\frac{\beta c_1}{2t}-\varphi_1 q_1+\frac{(1-\beta)p_1}{2t}-\frac{(1-\beta)c_1}{2t}=0$$

$$q_1=\frac{p_1-c_1}{2\varphi_1 t} \qquad \textbf{(C. 6)}$$

We replace q_1 and q_2 to p_2:

$$p_2 = \frac{2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} + 2\left(\frac{p_2 - c_2}{\varphi_2 t}\right) + 2(1-\beta)c_2 - \left(\frac{p_1 - c_1}{2\varphi_1 t}\right) + (1-\beta)p_1}{4(1-\beta)}$$

$$\left(4(1-\beta) - \frac{2}{\varphi_2 t}\right)p_2 = 2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} - \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2 + \left(1 - \beta - \frac{1}{2\varphi_1 t}\right)p_1$$

$$p_2 = \frac{\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} - \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right) + \left(1 - \beta - \frac{1}{2\varphi_1 t}\right)p_1}{4(1-\beta) - \frac{2}{\varphi_2 t}}$$

We replace q_1 and q_2 to p_1 :

$$p_1 = \frac{t - \left(\frac{p_1 - c_1}{2\varphi_1 t}\right) - \left(\frac{p_2 - c_2}{\varphi_2 t}\right) + (1-\beta)c_1 + (1-\beta)p_2}{2(1-\beta)}$$

$$2(1-\beta)p_1 - \frac{p_1}{2\varphi_1 t} = t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1 + \left(1 - \beta - \frac{1}{2\varphi_1 t}\right)p_2$$

$$p_1 = \frac{t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1 + \left(1 - \beta - \frac{1}{2\varphi_1 t}\right)p_2}{2(1-\beta) - \frac{1}{2\varphi_1 t}}$$

We substitute $p_1$to p_2 to get:

$$p_2 = \frac{\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} - \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right) + \left(1-\beta-\frac{1}{2\varphi_1 t}\right)\frac{t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1 + \left(1-\beta-\frac{1}{2\varphi_1 t}\right)p_2}{2(1-\beta) - \frac{1}{2\varphi_1 t}}}{4(1-\beta) - \frac{2}{\varphi_2 t}}$$

The final solution for p_2 is

$$p_2 = \frac{\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} + \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right)\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right) + \left(t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1\right)\left((1-\beta) - \frac{1}{2\varphi_1 t}\right)}{\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)}$$

(C. 7)

We substitute $p_1$to p_2 to get:

$$p_1 = \frac{t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1 + \left(1-\beta-\frac{1}{2\varphi_1 t}\right)\frac{\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} - \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right) + \left(1-\beta-\frac{1}{2\varphi_1 t}\right)p_1}{4(1-\beta) - \frac{2}{\varphi_2 t}}}{2(1-\beta) - \frac{1}{2\varphi_1 t}}$$

The final solution for p_1 is

$$p_1 = \frac{\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} + \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right)\left(1-\beta - \frac{1}{\varphi_2 t}\right) + \left(t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1\right)\left(4(1-\beta) - \frac{2}{\varphi_2 t}\right)}{\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)}$$

(C. 8)

2C.2 The comparative static in the adjusted model

The second order conditions are following:

$$\frac{\partial^2 \pi_{pv}}{\partial {p_2}^2} = -\frac{1}{2t}(1-\beta) - \frac{1}{2t}(1-\beta) - \frac{1}{2t}(1-\beta) - \frac{1}{2t}(1-\beta)$$
$$= -\frac{4}{2t}(1-\beta) \tag{C. 9}$$

$$\frac{\partial^2 \pi_{pv}}{\partial {q_2}^2} = -\varphi_2 \tag{C. 10}$$

$$\frac{\partial^2 \pi_{pv}}{\partial p_2 \partial q_2} = \frac{\beta}{2t} + \frac{\beta}{2t} + \frac{(1-\beta)}{2t} + \frac{(1-\beta)}{2t} = \frac{1}{t} \tag{C. 11}$$

$$\begin{vmatrix} -\frac{4}{2t}(1-\beta) & \frac{1}{t} \\ \frac{1}{t} & -\varphi_2 \end{vmatrix} = -\frac{4}{2t}(1-\beta).-\varphi_2 - \frac{1}{t}.\frac{1}{t}$$
$$= \frac{4(1-\beta)\varphi_2}{2t} - \frac{1}{t^2} \tag{C. 12}$$

$$\frac{2\varphi_2}{t}\left(4(1-\beta) - \frac{2}{\varphi_2 t}\right) > 0 \tag{C. 13}$$

$$\frac{\partial^2 \pi_{pv(DP)}}{\partial {p_2}^2} = -\frac{(1-\beta)}{2t} - \frac{1}{2t} + \frac{\beta}{2t} = \frac{-(1-\beta)}{t} \tag{C. 14}$$

$$\frac{\partial^2 \pi_{pv(DP)}}{\partial {q_2}^2} = -\varphi_1 \tag{C. 15}$$

$$\frac{\partial^2 \pi_{pv(DP)}}{\partial p_2 \partial q_2} = \frac{1}{2t} \tag{C. 16}$$

$$\begin{vmatrix} \frac{-(1-\beta)}{t} & \frac{1}{2t} \\ \frac{1}{2t} & -\varphi_1 \end{vmatrix} = \frac{-(1-\beta)}{t}.-\varphi_1 - \frac{1}{2t}.\frac{1}{2t}$$

$$= \frac{\frac{-(1-\beta)}{t}\varphi_1}{t} - \frac{1}{4t^2} \tag{C. 17}$$

$$\frac{\varphi_1}{2t}\left(2\frac{-(1-\beta)}{t} - \frac{1}{2\varphi_1 t}\right) > 0 \tag{C. 18}$$

The comparative static of β:

$$\beta = \frac{\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} + \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right)\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right) + \left(t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1\right)\left((1-\beta) - \frac{1}{2\varphi_1 t}\right)}{\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)}$$

$$\frac{\partial p_2}{\partial \beta}$$

$$= \frac{(-\widetilde{p_1} - c_2)\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right) + (-2)\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} + \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right)}{\left[\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)\right]^3}$$

$$+ \frac{(-1)\left(t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1\right) + (-c_1)\left((1-\beta) - \frac{1}{2\varphi_1 t}\right)}{\left[\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)\right]^3}$$

$$- \frac{\left[\left(2t - \widetilde{q_1} + (1-\beta)\widetilde{p_1} + \frac{2c_2}{\varphi_2 t} + \frac{c_1}{2\varphi_1 t} + (1-\beta)2c_2\right)\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right) + \left(t - \frac{c_1}{2\varphi_1 t} + \frac{c_2}{\varphi_2 t} + (1-\beta)c_1\right)\left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\right]}{\left[\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\times \frac{\left[(-2)\left(4(1-\beta) - \frac{2}{\varphi_2 t}\right) + (-4)\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right) + \left((1-\beta) - \frac{1}{\varphi_2 t}\right) + \left(1 - \beta - \frac{1}{2\varphi_1 t}\right)\right]}{\left[\left(2(1-\beta) - \frac{1}{2\varphi_1 t}\right)\left(4(1-\beta) - \frac{1}{\varphi_2 t}\right) - \left((1-\beta) - \frac{1}{2\varphi_1 t}\right)\left((1-\beta) - \frac{1}{\varphi_2 t}\right)\right]^2}$$

$$\frac{\partial p_2}{\partial \beta} > \qquad \textbf{(C. 19)}$$

2C3. Effect of insurance in long run total welfare

The total welfare with insurance is a summation of welfare of consumer, private facility, public facility, and government transfer.

$$\begin{aligned} &total\ welfare(TW^{NI}) \\ &\quad = welfare\ of\ consumer \\ &\quad + welfare\ of\ private\ facility \\ &\quad + welfare\ of\ public\ facility \\ &\quad + government\ transfer \end{aligned} \qquad \textbf{(C. 20)}$$

We assume that in this point, there is no quality choice in public facility and private facility and it is assumed equal qualities to make the analysis simpler and more intuitive. Hence $\widetilde{q_1} = {q_2}^{NI}$. We have $x_1^{am} = \frac{t - s\widetilde{p_1} + {p_2}^{NI}}{2t}$.

$$TW^{NI\,consumer}$$

$$= \int_0^{x_1^{am}} (y + \widetilde{q_1} - s\widetilde{p_1} - tx)dx$$

$$+ \int_{x_1^{am}}^1 \left(y + {q_2}^{NI} - s{p_2}^{NI} - t(1 - x)\right)dx$$

$$+ \int_0^1 \left(y + {q_2}^{NI} - s{p_2}^{NI} - t(1 - x)\right)dx$$

$$TW^{NI\,consumer}$$

$$= \frac{t - s\widetilde{p_1} + {p_2}^{NI}}{2t}(y - s\widetilde{p_1}) - \frac{t}{2}\left(\frac{t - s\widetilde{p_1} + {p_2}^{NI}}{2t}\right)^2$$

$$+ (y - s{p_2}^{NI} - t) - \frac{t - s\widetilde{p_1} + {p_2}^{NI}}{2t}(y - s{p_2}^{NI} - t)$$

$$+ \frac{t}{2} - \frac{t}{2}\left(\frac{t - s\widetilde{p_1} + {p_2}^{NI}}{2t}\right)^2 + (y - s{p_2}^{NI} - t) + \frac{t}{2} \qquad \textbf{(C. 21)}$$

$$TW^{NI\,private} = \int_{x_1^{am}}^1 (s{p_2}^{NI} - c_2)dx$$

$$+ \int_0^1 1.(s{p_2}^{NI} - c_2)dx - \varphi_2 \frac{{{q_2}^{NI}}^2}{2} \qquad \textbf{(C. 22)}$$

$$TW^{NI\,private} = (s{p_2}^{NI} - c_2) - \frac{t - s\widetilde{p_1} + {p_2}^{NI}}{2t}(s{p_2}^{NI} - c_2)$$

$$+ (s{p_2}^{NI} - c_2) - \varphi_2 \frac{{{q_2}^{NI}}^2}{2}$$

$$TW^{NI\,public} = \int_0^{x_1^{am}} (s\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2}$$

$$TW^{NI\,public} = \frac{t - s\widetilde{p_1} + p_2{}^{NI}}{2t}(s\widetilde{p_1} - c_1) - \varphi_1 \frac{\widetilde{q_1}^2}{2} \quad \textbf{(C. 23)}$$

$$TW^{NI\,government\,trasnfer}$$

$$= \int_0^{x_1^{am}} (1-s)\widetilde{p_1} + \int_{x_1^{am}}^1 (1-s)p_2{}^{NI}$$

$$+ \int_0^1 (1-s)p_2{}^{NI}$$

$$TW^{NI\,government\,trasnfer}$$

$$= \frac{t - s\widetilde{p_1} + p_2{}^{NI}}{2t}(1-s)\widetilde{p_1} + (1-s)p_2{}^{NI}$$

$$- \frac{t - s\widetilde{p_1} + p_2{}^{NI}}{2t}(1-s)p_2{}^{NI} + (1-s)p_2{}^{NI} \quad \textbf{(C. 24)}$$

We rewrite the total welfare for each part that contain s and $p_2{}^{NI}$.

$$TW^{NI\,consumer}$$

$$= -\frac{\widetilde{p_1}}{2t}s + \frac{\widetilde{p_1}^2}{4t}s^2 - \frac{3}{2}sp_2{}^{NI} + \frac{2st-1}{4t}p_2{}^{NI^2} \quad \textbf{(C. 25)}$$

$$- \frac{\widetilde{p_1}}{2t}s^2 p_2{}^{NI}$$

$$TW^{NI\,private} = \frac{3}{2}p_2{}^{NI}s + \frac{\widetilde{p_1}}{2t}p_2{}^{NI}s^2 - \frac{1}{2}p_2{}^{NI^2} - \frac{c_2\widetilde{p_1}}{2t}s + \frac{c_2}{2t}p_2{}^{NI} \quad \textbf{(C. 26)}$$

$$TW^{NI\,public} = \frac{\widetilde{p_1}t + c_1\widetilde{p_1}}{2t}s - \frac{\widetilde{p_1}}{2t}s^2 + \frac{\widetilde{p_1}}{2t}sp_2{}^{NI} - \frac{c_1}{2t}p_2{}^{NI} \quad \textbf{(C. 27)}$$

$$TW^{NI\,government\,trasnfer}$$
$$= \frac{-\widetilde{p_1}^2 - \widetilde{p_1}t}{2t}s + \frac{\widetilde{p_1}^2}{2t}s^2 + \frac{\widetilde{p_1} + 3t}{2t}p_2{}^{NI} - \frac{1}{2t}p_2{}^{NI^2} \quad \textbf{(C. 28)}$$

Then we find the $\frac{\partial TW^{\text{NI consumer}}}{\partial s}, \frac{\partial TW^{\text{NI private}}}{\partial s}, \frac{\partial TW^{\text{NI public}}}{\partial s}, \frac{\partial TW^{\text{NI government transfer}}}{\partial s}$

$$\frac{\partial TW^{\text{NI consumer}}}{\partial s}$$
$$= -\frac{\widetilde{p_1}}{2t} + 2\frac{\widetilde{p_1}^2}{4t}s - \frac{3}{2}p_2{}^{NI} - \frac{3}{2}sp_2{}^{NI'} + \frac{1}{2}p_2{}^{NI^2}$$
$$+ \frac{2st-1}{4t}p_2{}^{NI^{2'}} - 2\frac{\widetilde{p_1}}{2t}sp_2{}^{NI} - \frac{\widetilde{p_1}}{2t}s^2p_2{}^{NI'} \quad \textbf{(C. 29)}$$

$$TW^{NI\,private} = \frac{3}{2}p_2{}^{NI} + \frac{3}{2}sp_2{}^{NI'} + \frac{\widetilde{p_1}}{2t}2sp_2{}^{NI} + \frac{\widetilde{p_1}}{2t}s^2p_2{}^{NI'}$$
$$-\frac{1}{2}p_2{}^{NI^{2'}} - \frac{c_2\widetilde{p_1}}{2t} + \frac{c_2}{2t}p_2{}^{NI'} \quad \textbf{(C. 30)}$$

$$TW^{NI\,public} = \frac{\widetilde{p_1}t + c_1\widetilde{p_1}}{2t} - \frac{\widetilde{p_1}}{2t}2s + \frac{\widetilde{p_1}}{2t}p_2{}^{NI} + \frac{\widetilde{p_1}}{2t}sp_2{}^{NI'} - \frac{c_1}{2t}p_2{}^{NI'} \quad \textbf{(C. 31)}$$

$$TW^{NI\,government\,trasnfer}$$
$$= \frac{-\widetilde{p_1}^2 - \widetilde{p_1}t}{2t} + \frac{\widetilde{p_1}^2}{2t}2s + \frac{\widetilde{p_1} + 3t}{2t}p_2{}^{NI'} - \frac{1}{2t}p_2{}^{NI^{2'}} \quad \textbf{(C. 32)}$$

The ${p_2}^{NI}$ will be replaced with ${p_2}^{NI} = \frac{3t - \widetilde{q_1} + s\widetilde{p_1} + \left(s - \frac{1}{2\varphi_2 t}\right)c_2}{2\left(s - \frac{1}{4\varphi_2 t}\right)}$ and ${p_2}^{NI'}$, ${p_2}^{NI^{2'}}$ will be replaced with

$$ {p_2}^{NI'} = \frac{(\widetilde{p_1} + c_2)\left(2s - \frac{2}{4\varphi_2 t}\right) - 2\left(3t + s\widetilde{p_1} + \left(s - \frac{1}{2\varphi_2 t}\right)c_2\right)}{\left(2s - \frac{2}{4\varphi_2 t}\right)^2} \quad \textbf{(C. 33)} $$

$$ {p_2}^{NI^{2'}} = \frac{\begin{pmatrix} \left(6\widetilde{p_1}t + 4c_2 + 2\widetilde{p_1}s + 4c_2\widetilde{p_1} + 2{c_2}^2 s - \frac{2c_2\widetilde{p_1}}{2\varphi_2 t} - \frac{2c_2}{2\varphi_2 t}\right)\left(4\left(s - \frac{1}{4\varphi_2 t}\right)^2\right) \\ -\left(9t^2 + 6\widetilde{p_1}st + 4c_2 st + \widetilde{p_1}s + 2c_2\widetilde{p_1}s^2 + c_2 s^2 - \frac{6c_2 t - 2c_2\widetilde{p_1}s - 2{c_2}^2 s + {c_2}^2}{2\varphi_2 t}\right)\left(8s - \frac{2}{\varphi_2 t}\right) \end{pmatrix}}{\left[4\left(s - \frac{1}{4\varphi_2 t}\right)^2\right]^2} \quad \textbf{(C. 34)} $$

2C4. Effect of dual practice in long run total welfare

The profit function of private facility with dual practice effect

$$ {\pi_{pv}}^{DP} = D_2^{am}({p_2}^{DP}, \widetilde{p_1}, {q_2}^{DP}, \widetilde{q_1})(p_2^{DP} - c_2) + d.D_2^{pm}(p_2^{DP}, {q_2}^{DP})(p_2^{DP} - c_2) + (1 - d)D_2^{pm}(p_2^{DP}, {q_2}^{DP})(p_2^{DP} - c_2) - \varphi_2 \frac{{q_2}^{DP^2}}{2} $$

$$ {\pi_{pv}}^{DP} = {x_2}^{am}(p_2^{DP} - c_2) + d.{x_2}^{pm}.(p_2^{DP} - c_2) + (1 - d){x_2}^{pm}.(p_2^{DP} - c_2) - \varphi_2 \frac{{q_2}^{DP^2}}{2} \quad \textbf{(C. 35)} $$

$$\pi_{pv}{}^{DP} = \frac{t - \widetilde{q_1} + \widetilde{p_1} + q_2{}^{DP} - p_2^{DP}}{2t}(p_2^{DP} - c_2)$$

$$+ d.\frac{t - q_1{}^{DP} + p_1{}^{DP} + q_2{}^{DP} - p_2{}^{DP}}{2t}.(p_2^{DP} - c_2)$$

$$+ (1 - d).\frac{t - q_1{}^{DP} + p_1{}^{DP} + q_2{}^{DP} - p_2{}^{DP}}{2t}.(p_2^{DP}$$

$$- c_2) - \varphi_2 \frac{q_2{}^{DP^2}}{2}$$

(C. 36)

Setting $\frac{\partial \pi_{pv}{}^{Dp}}{\partial p_2{}^{DP}} = 0$, we get

$$p_2^{DP} = \frac{2t - \widetilde{q_1} + \widetilde{p_1} + 2q_2{}^{DP} - q_1{}^{DP} + p_1{}^{DP} + 2c_2}{4} \quad \textbf{(C. 37)}$$

Setting $\frac{\partial \pi_{pv}{}^{DP}}{\partial q_2{}^{DP}} = 0$, we get

$$q_2{}^{DP} = \frac{3p_2^{DP} - dp_2^{DP} - c_2}{2\varphi_2 t} \quad \textbf{(C. 38)}$$

The profit function in dual practice facility with dual practice effect,

$$\pi_{dp}{}^{DP} = d.\,D_1^{pm}(p_2{}^{DP}, p_1{}^{DP}, q_2{}^{DP}, q_1{}^{DP})(p_1{}^{DP} - c_1)$$

$$+ (1 - d).\,D_1^{pm}(p_2{}^{DP}, p_1{}^{DP}, q_2{}^{DP}, q_1{}^{DP})(p_1{}^{DP} - c_1)$$

$$- \varphi_1 \frac{q_1{}^{DP^2}}{2}$$

(C. 39)

$$\pi_{dp}{}^{DP} = d.\,x_1{}^{pm}.(p_1{}^{DP} - c_1) + (1 - d)x_1{}^{pm}(p_1^{DP} - c_2)$$

$$- \varphi_1 \frac{q_1{}^{DP^2}}{2}$$

$$\pi_{pv}{}^{DP} = d.\frac{t + q_1{}^{DP} - p_1{}^{DP} - q_2{}^{DP} + p_2{}^{DP}}{2t}.(p_1^{DP} - c_2) + (1-d).\frac{t + q_1{}^{DP} - p_1{}^{DP} - q_2{}^{DP} + p_2{}^{DP}}{2t}.(p_1^{DP} - c_2) - \varphi_1\frac{q_1{}^{DP^2}}{2} \tag{C. 40}$$

Setting $\frac{\partial \pi_{pv(DP)}{}^{DP}}{\partial p_1{}^{DP}} = 0$, we get

$$p_1^{DP} = \frac{t + q_1{}^{DP} - q_2{}^{DP} + p_2{}^{DP} + c_1}{2} \tag{C. 41}$$

Setting $\frac{\partial \pi_{pv(DP)}{}^{DP}}{\partial q_1{}^{DP}} = 0$, we get

$$q_1{}^{DP} = \frac{p_1^{DP} - c_1}{2\varphi_1 t} \tag{C. 42}$$

Replace $q_1{}^{DP}$ and $q_2{}^{DP}$ in p_2^{DP} and p_1^{DP}

$$p_2^{DP} = \frac{2t - \widetilde{q_1} + \widetilde{p_1} + 2\frac{3p_2^{DP} - dp_2^{DP} - c_2}{2\varphi_2 t} - \frac{p_1^{DP} - c_1}{2\varphi_1 t} + p_1{}^{DP} + 2c_2}{4} \tag{C. 43}$$

$$p_1^{DP} = \frac{t + \frac{p_1^{DP} - c_1}{2\varphi_1 t}^{DP} - \frac{3p_2^{DP} - dp_2^{DP} - c_2}{2\varphi_2 t} + p_2{}^{DP} + c_1}{2} \tag{C. 44}$$

We get p_2^{DP} and p_1^{DP}

$$p_2^{DP} = \frac{2\varphi_2 t^2 - \widetilde{q_1}\varphi_2 t + \widetilde{p_1}\varphi_2 t - 2c_2 + 2c_2\varphi_2 t}{4\varphi_2 t - 3 + d} + \frac{c_1\varphi_2 t}{(4\varphi_2 t - 3 + d)(2\varphi_1 t)} + \frac{\varphi_2 t(2\varphi_1 t - 1)}{(4\varphi_2 t - 3 + d)(2\varphi_1 t)} p_1^{DP} \quad \textbf{(C. 45)}$$

$$p_1^{DP} = \frac{2\varphi_1 t^2 - c_1 + 2c_1\varphi_1 t}{4\varphi_1 t - 1} + \frac{2c_2}{(4\varphi_1 t - 1)(2\varphi_2 t)} + \frac{4\varphi_1 t\varphi_2 t + d - 3}{(4\varphi_1 t - 1)(2\varphi_2 t)} p_2^{DP} \quad \textbf{(C. 46)}$$

Substituting p_2^{DP} to p_1^{DP} and p_1^{DP} to p_2^{DP} result on the solution of p_1^{DP} to p_2^{DP},

$$p_2^{DP} = \frac{(2\varphi_2 t^2 - \widetilde{q_1}\varphi_2 t + \widetilde{p_1}\varphi_2 t - 2c_2 + 2c_2\varphi_2 t)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) + (c_1\varphi_2 t)(4\varphi_1 t - 1)(2\varphi_2 t)}{(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)} + \frac{(\varphi_2 t)(2\varphi_1 t - 1)(2\varphi_1 t^2 - c_1 + 2c_1\varphi_1 t)(2\varphi_2 t) + (\varphi_2 t)(2\varphi_1 t - 1)(2c_2)}{(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)} \quad \textbf{(C. 47)}$$

$$p_1^{DP} = \frac{(2x_1 t^2 - c_1 + 2c_1 x_1 t)(2x_1 t)(4\varphi_2 t - 3 + d)(2\varphi_2 t) + (2c_2)(2x_1 t)(4\varphi_2 t - 3 + d)}{(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)} + \frac{(4\varphi_1 t\varphi_2 t - 3 + d)(2x_1 t)(2\varphi_2 t^2 - \widetilde{q_1}\varphi_2 t + \widetilde{p_1}\varphi_2 t - 2c_2 + 2c_2\varphi_2 t) + (4\varphi_1 t\varphi_2 t - 3 + d)(c_1 x_2 t)}{(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)} \quad \textbf{(C. 48)}$$

Composing total welfare (TW):

$$TW = TW^{consumer} + TW^{private} + TW^{public}$$

$$TW^{consumer} = \int_0^{x_1^{am}} (y + \widetilde{q_1} - \widetilde{p_1} - tx)dx$$

$$+ \int_{x_1^{am}}^1 (y + {q_2}^{DP} - {p_2}^{DP} - t(1-x))dx$$

$$+ \int_0^{x_1^{pm}} (y + {q_1}^{DP} - {p_1}^{DP} - tx)dx$$

$$+ \int_{x_1^{pm}}^1 (y + {q_2}^{DP} - {p_2}^{DN} - t(1-x))dx \quad \textbf{(C. 49)}$$

$$TW^{private} = \left(\int_{x_1^{am}}^1 ({p_2}^{DP}, \widetilde{p_1}, {q_2}^{DP}, \widetilde{q_1})({p_2}^{DP} - c_2)dx\right.$$

$$+ \int_{x_1^{pm}}^1 ({p_2}^{DP}, {p_1}^{DP}, {q_2}^{DP}, {q_1}^{DP})({p_2}^{DP} - c_2)dx$$

$$\left. - \varphi_2 \frac{{q_2^{DP}}^2}{2}\right)$$

$$+ \left(\int_0^{x_1^{pm}} ({p_2}^{DP}, {p_1}^{DP}, {q_2}^{DP}, {q_1}^{DP})({p_1}^{DP} - c_1)dx\right.$$

$$\left. - \varphi_1 \frac{{q_1^{DP}}^2}{2}\right) \quad \textbf{(C. 50)}$$

$$TW^{public} = \int_0^{x_1^{am}} ({p_2}^{DP}, \widetilde{p_1}, {q_2}^{DP}, \widetilde{q_1})(\widetilde{p_1} - c_1)dx - \varphi_1 \frac{\widetilde{q_1}^2}{2} \quad \textbf{(C. 51)}$$

Assumed that no quality choice in public and private facility.

$$TW^{consumer} = \frac{t - \widetilde{p_1} + p_2}{2t}(y - \widetilde{p_1} - tx)$$
$$+ 1.(y - {p_2}^{DP} - t(1-x))$$
$$- \frac{t - \widetilde{p_1} + {p_2}^{DP}}{2t}\left(y - {p_2}^{DP} - t(1-x)\right)$$
$$+ \frac{t - {p_1}^{DP} + {p_2}^{DP}}{2t}(y - {p_1}^{DP} - tx)$$
$$+ 1.(y - {p_2}^{DN} - t(1-x))$$
$$- \frac{t - {p_1}^{DP} + {p_2}^{DP}}{2t}(y - {p_2}^{DP} - t(1-x)) \quad \textbf{(C. 52)}$$

$$TW^{private} = 1.({p_2}^{DP} - c_2) - \frac{t - \widetilde{p_1} + p_2}{2t}({p_2}^{DP} - c_2)$$
$$+ 1.({p_2}^{DP} - c_2) - \frac{t - {p_1}^{DP} + {p_2}^{DP}}{2t}({p_2}^{DP} - c_2)$$
$$+ \frac{t - {p_1}^{DP} + {p_2}^{DP}}{2t}({p_1}^{DP} - c_1) \quad \textbf{(C. 53)}$$

$$TW^{public} = \frac{t - \widetilde{p_1} + p_2}{2t}(\widetilde{p_1} - c_1) \quad \textbf{(C. 54)}$$

To get $\frac{\partial TW^{consumer}}{\partial d}$, $\frac{\partial TW^{private}}{\partial d}$, $\frac{\partial TW^{public}}{\partial d}$, first we rearrange the total welfare of consumer, total welfare of private facility, and total welfare of public facility that contain of ${p_1}^{DP}$ and ${p_2}^{DP}$, because $d$component only appears in those two variables.

$$TW^{consumer} = \left(\frac{-\widetilde{p_1} - 2t}{2t}\right) {p_2}^{DP} + \left(\frac{1}{2t}\right) {p_2}^{DP^2} + \left(\frac{1}{4t}\right) {p_1}^{DP^2} - \left(\frac{1}{2t}\right) {p_1}^{DP} {p_2}^{DP} - \left(\frac{1}{2}\right) {p_1}^{DP} \quad \textbf{(C. 55)}$$

$$TW^{private} = \frac{2t + \widetilde{p_1} + 2c_2 - c_1}{2t} {p_2}^{DP} + \frac{t + c_1 - c_2}{2t} {p_1}^{DP} + \frac{1}{t} {p_1}^{DP} {p_2}^{DP} - \frac{1}{t} {p_2}^{DP^2} - \frac{1}{2t} {p_1}^{DP^2} \quad \textbf{(C. 56)}$$

$$TW^{public} = \left(\frac{\widetilde{p_1} - c_1}{2t}\right) {p_2}^{DP} \quad \textbf{(C. 57)}$$

We replace ${p_1}^{DP}$ and ${p_2}^{DP}$ with the new equilibrium prices in C.47 and C.48 and find the $\frac{\partial TW^{consumer}}{\partial d}, \frac{\partial TW^{private}}{\partial d}, \frac{\partial TW^{public}}{\partial d}$.

$$\frac{\partial TW^{consumer}}{\partial d} = \left(\frac{-\widetilde{p_1} - 2t}{2t}\right) {p_2}^{DP} {p_2}^{DP'} + \left(\frac{1}{2t}\right) {p_2}^{DP^2} ({p_2}^{DP})^{2'} + \left(\frac{1}{4t}\right) {p_1}^{DP^2} ({p_1}^{DP})^{2'} - \left(\frac{1}{2t}\right) {p_1}^{DP} {p_2}^{DP'} + {p_2}^{DP} {p_1}^{DP'} - \left(\frac{1}{2}\right) {p_1}^{DP} {p_1}^{DP'} \quad \textbf{(C. 58)}$$

$$\frac{\partial TW^{private}}{\partial d} = \frac{2t + \widetilde{p_1} + 2c_2 - c_1}{2t} {p_2}^{DP} {p_2}^{DP'} - \frac{1}{t} {p_2}^{DP^2} ({p_2}^{DP})^{2'} - \frac{1}{2t} {p_1}^{DP^2} ({p_1}^{DP})^{2'} + \frac{1}{t} {p_1}^{DP} {p_2}^{DP'} + {p_2}^{DP} {p_1}^{DP'} + \frac{t + c_1 - c_2}{2t} {p_1}^{DP} {p_1}^{DP'} \quad \textbf{(C. 59)}$$

$$\frac{\partial TW^{public}}{\partial d} = \left(\frac{\widetilde{p_1} - c_1}{2t}\right) {p_2}^{DP} {p_2}^{DP'} \tag{C. 60}$$

The ${p_1}^{DP'}$, ${p_2}^{DP'}$, $({p_1}^{DP})^{2'}$, $({p_2}^{DP})^{2'}$ will be replaced with the following,

$${p_2}^{DP'} = \frac{\partial {p_2}^{DP}}{\partial d}$$

$$= \frac{\begin{pmatrix} \left(2\varphi_2 t^2 - \widetilde{q_1}\varphi_2 t + \widetilde{p_1}\varphi_2 t - 2c_2 + 2c_2\varphi_2 t\right)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) + (c_1\varphi_2 t)(4\varphi_1 t - 1)(2\varphi_2 t) \\ +(\varphi_2 t)(2\varphi_1 t - 1)(2\varphi_1 t^2 - c_1 + 2c_1\varphi_1 t)(2\varphi_2 t) + (\varphi_2 t)(2\varphi_1 t - 1)(2c_2) \end{pmatrix}}{[(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)]^2}$$

$$\times \frac{16(\varphi_1 t)^2 - 6\varphi_2 t\varphi_1 t + \varphi_2 t}{[(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)]^2}$$

(C. 61)

$${p_1}^{DP'} = \frac{\partial {p_1}^{DP}}{\partial d}$$

$$= \frac{\begin{pmatrix} \left(\left(2x_1 t^2 - c_1 + 2c_1 x_1 t\right)(2x_1 t)(2\varphi_2 t) + (2c_2)(2x_1 t) + (2x_1 t)\left(2\varphi_2 t^2 - \widetilde{q_1}\varphi_2 t + \widetilde{p_1}\varphi_2 t - 2c_2 + 2c_2\varphi_2 t\right) + (c_1\varphi_2 t)\right) \\ \left((4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)\right) \end{pmatrix}}{[(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)]^2}$$

$$- \frac{\begin{pmatrix} \begin{pmatrix} \left(2x_1 t^2 - c_1 + 2c_1 x_1 t\right)(2x_1 t)(4\varphi_2 t - 3 + d)(2\varphi_2 t) + (2c_2)(2x_1 t)(4\varphi_2 t - 3 + d) + (4\varphi_1 t\varphi_2 t - 3 + d)(2x_1 t)\left(2\varphi_2 t^2 - \widetilde{q_1}\varphi_2 t + \widetilde{p_1}\varphi_2 t - 2c_2 + 2c_2\varphi_2 t\right) \\ +(4\varphi_1 t\varphi_2 t - 3 + d)(c_1\varphi_2 t) \end{pmatrix} \\ (16(\varphi_1 t)^2 - 6\varphi_2 t\varphi_1 t + \varphi_2 t) \end{pmatrix}}{[(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)]^2}$$

(C. 62)

$$({p_2}^{DP})^{2'} = \frac{\partial ({p_2}^{DP})^2}{\partial d}$$

$$= \frac{\begin{pmatrix} \left(2\varphi_2 t^2 - \widetilde{q_1}\varphi_2 t + \widetilde{p_1}\varphi_2 t - 2c_2 + 2c_2\varphi_2 t\right)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) + (c_1\varphi_2 t)(4\varphi_1 t - 1)(2\varphi_2 t) \\ +(\varphi_2 t)(2\varphi_1 t - 1)(2\varphi_1 t^2 - c_1 + 2c_1\varphi_1 t)(2\varphi_2 t) + (\varphi_2 t)(2\varphi_1 t - 1)(2c_2) \end{pmatrix}^2}{[(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)]^2}$$

$$\times \frac{(16(\varphi_1 t)^2 - 6\varphi_2 t\varphi_1 t + \varphi_2 t)^2}{[(4\varphi_2 t - 3 + d)(2\varphi_1 t)(4\varphi_1 t - 1)(2\varphi_2 t) - (2\varphi_2 t)(2\varphi_1 t - 1)(4\varphi_1 t\varphi_2 t - 3 + d)]^2}$$

(C. 63)

$$({p_1}^{DP})^{2'} = \frac{\partial ({p_1}^{DP})^2}{\partial d}$$

$$= \frac{\left(\frac{\left(\left((2x_1t^2-c_1+2c_1x_1t)(2x_1t)(2\varphi_2t)\right)^2.2d+\left((2c_2)(2x_1t)\right)^2.2d+\left((2x_1t)\left(2\varphi_2t^2-\widetilde{q_1}\varphi_2t+\widetilde{p_1}\varphi_2t-2c_2+2c_2\varphi_2t\right)\right)^2.2d+(c_1\varphi_2t)^2.2d\right)}{\left((4\varphi_2t-3+d)(2\varphi_1t)(4\varphi_1t-1)(2\varphi_2t)-(2\varphi_2t)(2\varphi_1t-1)(4\varphi_1t\varphi_2t-3+d)\right)^2}\right)}{[(4\varphi_2t-3+d)(2\varphi_1t)(4\varphi_1t-1)(2\varphi_2t)-(2\varphi_2t)(2\varphi_1t-1)(4\varphi_1t\varphi_2t-3+d)]^4}$$

$$- \frac{\left(\frac{\left(\begin{matrix}(2x_1t^2-c_1+2c_1x_1t)(2x_1t)(4\varphi_2t-3+d)(2\varphi_2t)+(2c_2)(2x_1t)(4\varphi_2t-3+d)+(4\varphi_1t\varphi_2t-3+d)(2x_1t)\left(2\varphi_2t^2-\widetilde{q_1}\varphi_2t+\widetilde{p_1}\varphi_2t-2c_2+2c_2\varphi_2t\right)\\+(4\varphi_1t\varphi_2t-3+d)(c_1\varphi_2t)\end{matrix}\right)^2}{(16(\varphi_1t)^2-6\varphi_2t\varphi_1t+\varphi_2t)^2}\right)}{[(4\varphi_2t-3+d)(2\varphi_1t)(4\varphi_1t-1)(2\varphi_2t)-(2\varphi_2t)(2\varphi_1t-1)(4\varphi_1t\varphi_2t-3+d)]^4}$$

(C. 64)

2D The welfare of dual practice and insurance

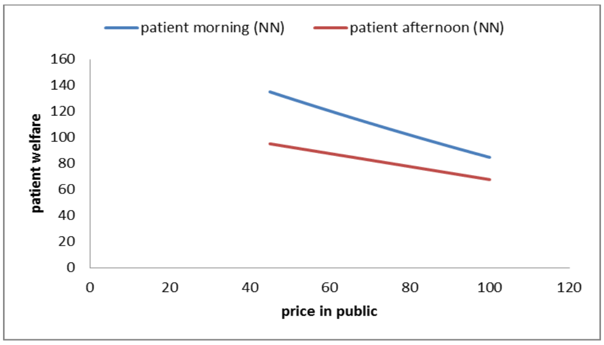

Figure 2.D.1: Patient welfare in the morning and in the afternoon under NN regime uses variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200, (1-s) = 0.4; 45 \leq \widetilde{p_1} \leq 100$.

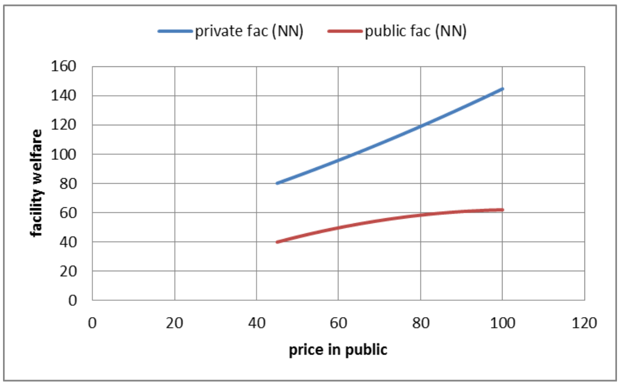

Figure 2.D.2: Welfare of public facility and welfare of private facility under NN regime using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200, (1-s) = 0.4; 45 \leq \widetilde{p_1} \leq 100$.

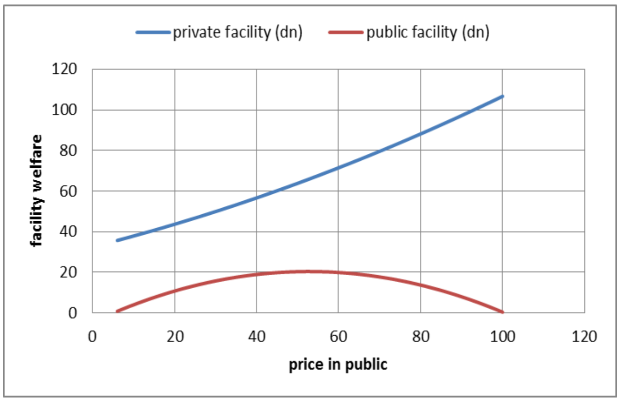

Figure 2.D.3: Welfare of public facility and welfare of private facility under DN regime using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200, (1-s) = 0.4; 6 \leq \widetilde{p_1} \leq 100$.

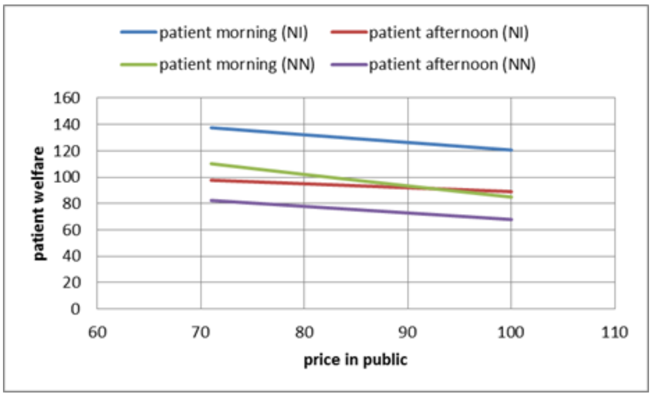

Figure 2.D.4: Welfare of patient in the morning and welfare of patient in the afternoon under NN and NI regimes using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200, (1-s) = 0.4; 71 \leq \widetilde{p_1} \leq 100.$

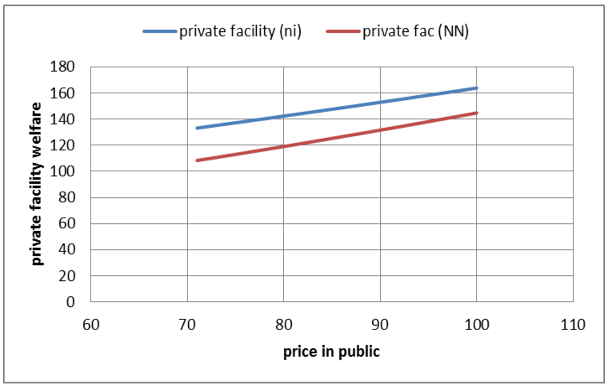

Figure 2.D.5: Welfare of public facility and welfare of private facility under NN and NI regimes using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200, (1-s) = 0.4; 71 \leq \widetilde{p_1} \leq 100.$

Figure 2.D.6: Total welfare of NN and NI regimes using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200, (1-s) = 0.2\ and\ 0.8; 71 \leq \widetilde{p_1} \leq 100.$

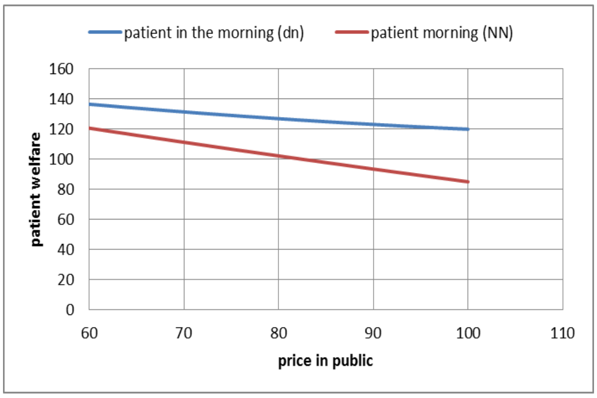

Figure 2.D.7: Welfare of patient in the morning under NN and DN regimes using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200; 60 \leq \widetilde{p_1} \leq 100.$

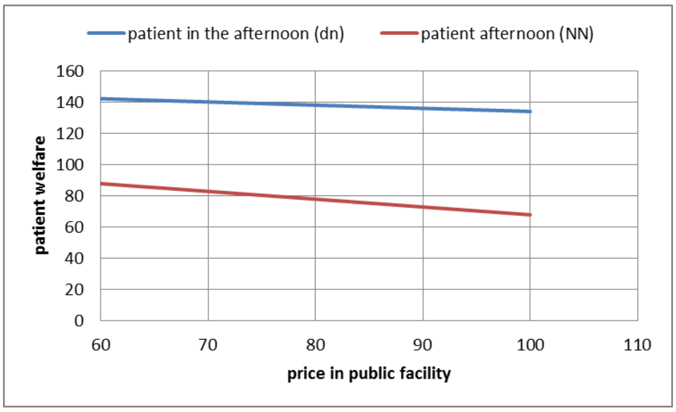

Figure 2.D.8: Welfare of patient in the afternoon under DN and NI regimes using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200; 60 \leq \widetilde{p_1} \leq 100.$

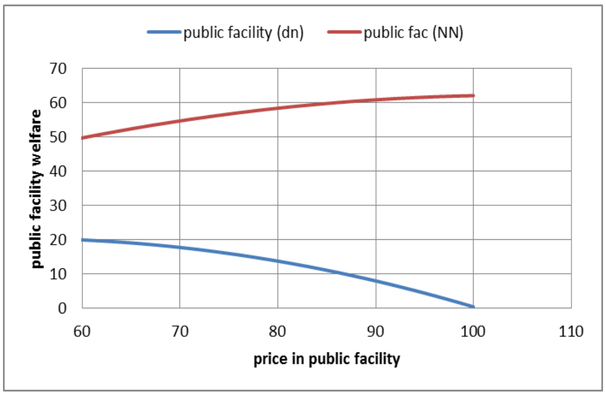

Figure 2.D.9: Welfare of public facility under NN and DN regimes using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200; 60 \leq \widetilde{p_1} \leq 100.$

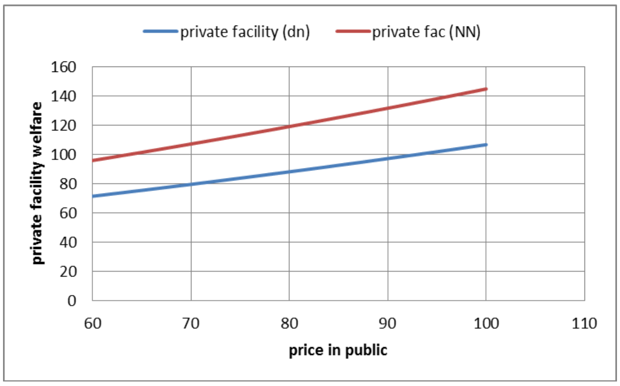

Figure 2.D.10: Welfare of private facility under NN and DN regimes using variables of $\varphi_1 = 2;\ \varphi_2 = 2; t = 40;\ \widetilde{q_1} = 0.1;\ c_1 = 5;\ c_2 = 5; y = 200; 60 \leq \widetilde{p_1} \leq 100.$

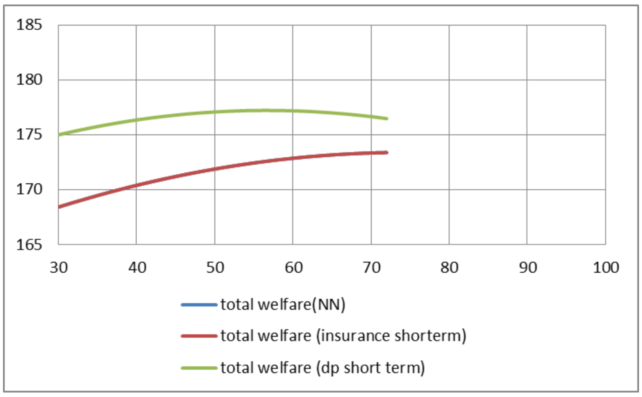

Figure 2.D.11:Total welfare of insurance **short run effect** using variables of $\varphi_1 = 2;\ \varphi_2 = 2; \widetilde{q_1} = 0.1;\ t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100;\ s = 1.$

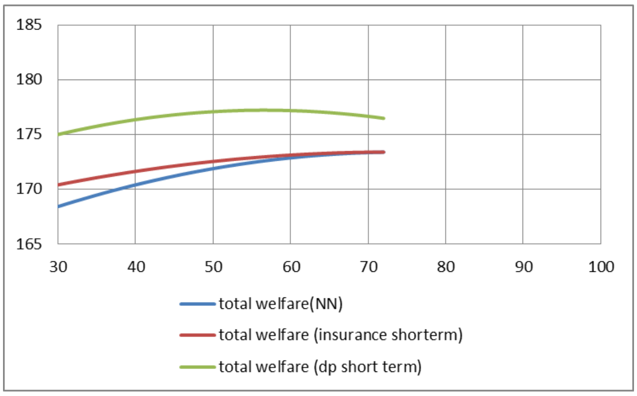

Figure 2.D.12:Total welfare of insurance **short run effect** using variables of $\varphi_1 = 2;\ \varphi_2 = 2; \widetilde{q_1} = 0.1;\ t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100;\ 1 - s = 0.2.$

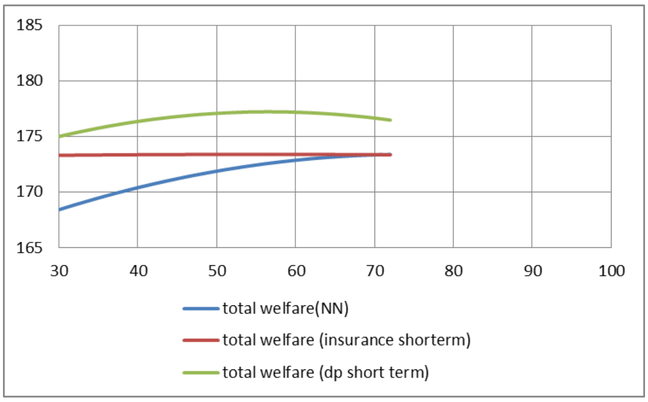

Figure 2.D.13:Total welfare of insurance **short run effect** using variables of $\varphi_1 = 2;\ \varphi_2 = 2; \widetilde{q_1} = 0.1;\ t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100;\ 1 - s = 0.8.$

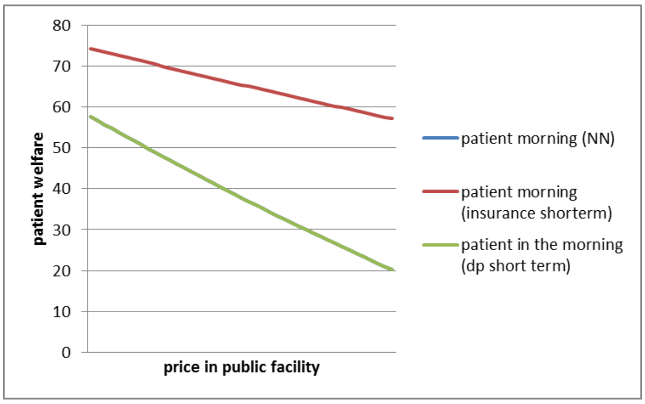

Figure 2.D.14, patient welfare in the morning in the **short run effect** using variables of $\varphi_1 = 2;\ \varphi_2 = 2; \widetilde{q_1} = 0.1;\ t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100;\ 0 < s \leq 1.$

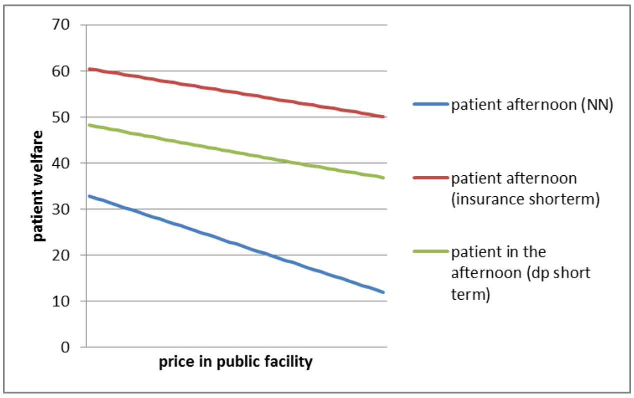

Figure 2.D.15: patient welfare in the afternoon in the **short run effect** using variables of $\varphi_1 = 2;\ \varphi_2 = 2; \widetilde{q_1} = 0.1;\ t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100;\ 0 < s \leq 1.$

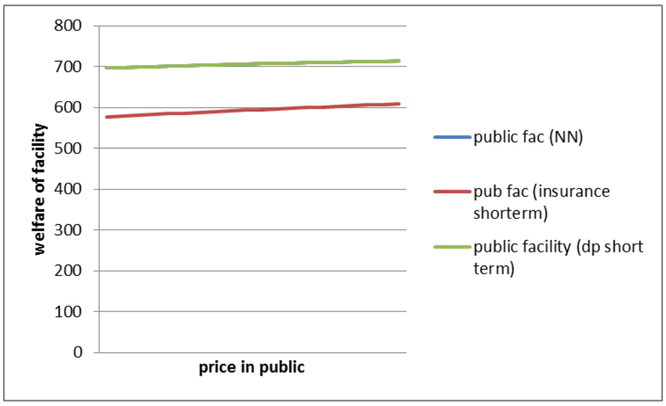

Figure 2.D.16: Welfare of public facility in the morning and afternoon in the **short run effect** using variables of $\varphi_1 = 2$; $\varphi_2 = 2; \widetilde{q_1} = 0.1$; $t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100$; $0 < s \leq 1$.

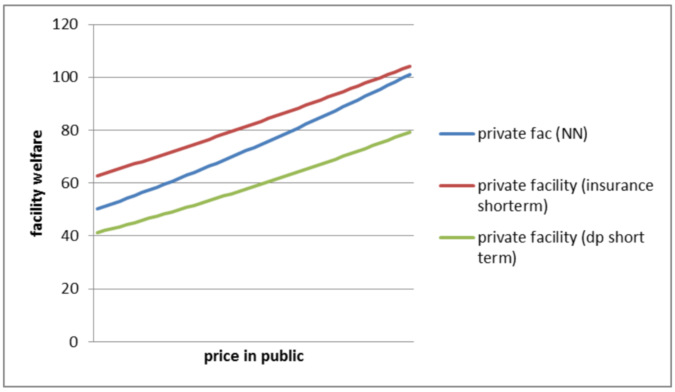

Figure 2.D.17: Welfare of private facility in the morning and afternoon in the **short run effect** using variables of $\varphi_1 = 2$; $\varphi_2 = 2; \widetilde{q_1} = 0.1$; $t = 25; c_1 = 2; c_2 = 5; 0 \leq \widetilde{p_1} \leq 100; y = 100$; $0 < s \leq 1$.

Chapter 3

Dual Physician Practice and Health Care Demand in Developing Country Study Case in Indonesia Using IFLS Data

Abstract

This research analyses the role of dual practice to demand of health care, and relationship with other factors such as monetary factors, non-monetary factors, and individual characteristics. The quality aspects of health care facility are included in the study to investigate whether people consider about quality when deciding health care services. We utilize data of Indonesian Family Life Survey (IFLS) 2014. We use multinomial logit to analyse the dual practice and insurance relation to health care demand and employ logit model to explain quality factors effect on health care demand. Evaluating policy simulations to show whether dual practice or insurance have more significant direct impact on health care demand. The results show that dual practice physician has indirect effect on health care demand, while insurance has direct significant effect on influencing individual health care demand. Dual practice policy might work differently as it has larger effect in community level. The complicacy to observe quality for individual and the priority to get treatment make quality factor getting less attention.

Keywords: health care demand, dual practice, quality, Indonesia

3.1 Introduction

The purpose of this research is to analyse how health care access instruments which here refer to dual practice physician and insurance coverage, influence individual decision to seek treatment. The study focuses on the outpatient care and non-emergency case using Indonesian Family Life Survey (IFLS) wave 5 in 2014. This study analyses the demand of health care in a developing country, using Indonesia as a case of study. The focus is emphasizing on how dual practice existence which is measured in percentage of dual practice physician in the area influences patient's decision on selecting health care facilities. We describe the role of two policy instruments to improve health care access which are dual practice physician and insurance coverage. We make an assessment on how strong each policy influences individual health care demand. The study is conditional on individuals who decide to get outpatient care during the period of illness. We further investigate whether the individuals are considering the quality aspects when deciding a health care facility to visit. We control monetary factors such as income and treatment price, non-monetary factors such as travel cost and waiting time, and individual characteristics as factors that affecting demand of health care and have essential role in individual's decision of health care facility. The main contribution of this research is that our research highlights the dual practice physician role in the demand of healthcare. We compare between dual practice and insurance coverage in order to evaluate how these policies affect the health care system. We will show that the size of effects between two policies might be different because health insurance is targeting to individual while the dual practice is influencing more to community level. This study provides empirical evidence of dual practice from developing country to support decision making regarding the future challenge of dual practice policy.

Access to health services has been an important agenda to improve people's quality of life and obtain the best health outcomes. Many countries have committed to agree on realizing the Sustainable Development Goals in 2015, a commitment program to improve health care access and quality life. World Health Organization puts access to health service as a fundamental step to guarantee health for all where everyone can access health services without facing financial hardship. Based on WHO recommendation, health care access should be achieved by following the three steps: gaining into the health care system, accessing a location where the services are provided, and finding a health care provider where patients put their trust. Our research translates the first two aspects as financial capability by measuring insurance coverage and supply side access policy by dual practice physician. The last aspect becomes our main purpose in this chapter by analysing how people select health care provider when they need health care treatment.

Dual practice among health workers is a dual job holding to work in both sectors, public and private. The presence of dual practice physicians is a tool for health care access enhancement in many developing countries. The characteristics of developing countries usually are described as a system with limited resources such as lack of facilities or shortage on medical personnel. These are some of common obstacles in providing public health care for entire residents, moreover densely and unevenly distribution population creates complication accessing health care in particular areas such as remote location or rural areas. Along with the development in health care sector, the government is required to provide health care services and people are encouraged to utilize formal health care provided by physician rather than visit non-physician facility (nurse, midwife) or use non-formal treatment such as self-treatment or traditional healer. In the case of limited number of physicians, the dual practice usually takes place and public physicians provide additional health care service after their public office hour so that people in need can get health care treatments. Dual practice physicians purposely serve people who cannot reach public health care facility by opening private practice in different location or different opening time from public practice. Therefore, health care access enhancement as one of the primary objectives of dual practice can be achieved. From different point of view, health care access can be interpreted as the financial capability from a patient to get services in adequate time. Patients should be able to get health care treatment regardless their financial ability. The attempt to increase access can be done through government doing price intervention or providing insurance scheme. The latter refers to increase the number of insurance beneficiaries by volunteer participation or subsidized enrolment.

Dual physician practice appears in most developing countries to compensate low salary among public physician. Among many limitations, health care systems in developing countries have usually characterized by a limited budget, scarcity of health care personnel, and loose regulations of dual practice physician. The principal argument of dual practice existence is that it provides more access to health care, especially in rural and remote areas. The growing of private sector and the implementing of recent program called universal coverage where each person will have the assurance to access health care when needed brings health situation changes in the most dynamic way. Therefore more aspects are required to be adapted to recent situations. The question on maintaining dual practice physicians in health care system then appears, but first, we should analyse the advantage and disadvantage of dual physician practice in the system.

One of the advantages from having dual practice in the system is to cut long waiting time that usually appears in public facility. It also means better health care access for population. Hipgrave & Hort (2013) in their paper mention some disadvantages of dual practice. This practice is believed to responsible for high rate of physician absenteeism on public working hours, patient diversion to private clinics that creates financial motive of dual practice, low effort to maintain efficiency and quality of treatment in public health care facility, and indication to neglect the poor. Although dual practice physician is accepted as usual practice in health care system, the net effect is not yet to be defined. As a response, different health care system provides different regulation to manage dual practice physician.

Most of the recent literature of dual practice usually analyzes the motives of physician working in dual jobs, while the empirical proof of whether dual practice improves welfare is still scant (Barros & Siciliani, 2009). Dual practice studies appear more often in the theoretical discussion that relies on modelling. This approach is useful regarding the limitation of dual practice evidence in a specific condition. Dual practice physician offers treatment in his private facility outside his regular working hours. It is often the case in developing country that physician also serves in rural and remote areas where public services is limited hence creating demand for private providers (Gruen, Anwar, Begum, Killingsworth, & Normand, 2002). Dual practice affects the treatment quality trough referral channel, whether it is direct referral when physician explicitly suggests patient to his private office or indirect one by inducing referral demand. The referral procedure diverts patient from public to private is by reducing quality of public service and lengthening waiting times or waiting lists in public sector (Jan, Bian, Jumpa, Meng, Nyazema, Prakongsai, et al., 2005; Biglaiser & Ma, 2006). Quality of health care is more difficult to assess by the patients, while patients easily observe variable such as public waiting time. In the case of rationed waiting list admission, waiting time in public increases when physician has a private practice (Iversen, 1997). The empirical evidences mostly appear for the case of developed country such as in France (France, Taroni, & Donatini, 2005), UK and Canada (Garcia-Prado & Gonzalez, 2011). Allowing physician to work in the private sector benefits all patients, as it is explained by Delfgaauw (2007). The rich patient self-selects to private sector so that public sector can be more efficiently dedicated to poor ones without hampering the quality because the altruism physician still provides optimal treatment in public. In term of quality, dual practice benefits the public facility when physician performs optimal treatment to gain reputation for his private facility (Gonzalez, 2004). The theoretical part uses assumptions that sometimes ignore details in the existence of dual practice of the real world, especially the case of dual practice in developing countries where the practice is common but the study related this issue is still scarce. Therefore empirical research related dual physician practice is still needed.

The health care systems in developing countries are mostly mixed health care systems, where both public and private sectors stand side by side to provide health care services for the population. The differentiation between public and private sectors can be classified based on the ownership, where public sector is owned by government and private sector is a facility owned by private person or private company. Based on data availability, this research identifies the public sector as a community health center and the private sector consists of private clinics and private physician practice. We emphasize the important fact that in our research, treatment fee in public health care facility is not free. The fee in public sector has the same mechanism in private sector that it will be determined based on diagnosis group. Related with insurance mechanism, patients will pay less for the treatment fee as a form of copayment or get reimbursement after paying in full fee if patients are covered in an insurance scheme. In this research, the insurance scheme applies for the services in public or private sector but not applies to nurse practice, midwife practice, or traditional healer.

The connection between dual physician practice and access to health care can be translated into two different kinds of health care demand. The first is when dual practice physician creates demand expansion. Patients who live far away from public health care facility or unable to come to public facility because limited working hours, without private facility nearby they might rely more on self-treatment or traditional healer. Dual practice physicians present a solution to formal health care while they provide services that are more affordable in distance and with more flexible opening hours. Secondly, a demand diversion as dual practice physician provides alternative choices. With a presence of dual practice physician, patients who queuing to get service from a particular physician in public sector now can receive service from the same physician in his private practice. This kind of demand means that dual practice physician affect patient's choice of provider. The demand for health care relates to the individual's seeking behavior of medical treatment for example people will decide to get treatment from public provider, private facility or non-formal option such as traditional healer. The decision is triggered by individual's need of health care. The perceived need leads to the demand for health care so that individual decides to visit or not visit a medical facility. After an Individual decides to visit a medical facility, he will decide in which facility to come based on several considerations, such as available price, income available, and quality.

The paper is organized as follows. In sub chapter 3.2, we provide literature review regarding empirical studies on health care demand and our testable hypothesis. In Sub chapter 3.3, we present the health care demand in Indonesia that will describe health situation in Indonesia and data source for this research. In sub chapter 3.4, we discuss the strategy of identification and estimators. Sub chapter 3.5 describes the result from descriptive statistics while the main results are in Chapter 3.6. The next sub chapter of 3.7 provides policy implications. The last sections are discussion and conclusion.

3.2 Literature Review and Testable Hypothesis

Literature on choice of health care provider is available with variety of motivations. Goddard and Smith (1998) model the demand of health care where public and private cares can be found at the same time. Individual can choose between no care, public care and private care by considering the illness severity, the cost and quality of public care as well as the cost and quality of private quality care. Goddard and Smith (2001) describe the treatment decision as the usual economic choices that benefit perceived by the patient exceeds the perceived cost to the individual. Their theoretical discussion mentioned that the probability of receiving treatment depends on benefit of treatment individual cost to facility such as travel cost, quality preference such as treatment delay, relative quality such as waiting time, and individual cost to alternative facility. Propper (2000) analyses the model of health care services in UK among the choice of public, private or no care. She investigates the demand for a hospital, physician, dental and other services. It shows that private care is related with individual income, demographic characteristics, and political affiliation. Hanson et al. (2004) emphasizes the role of quality and waiting time that affect the choice between public and private sectors. They compose individual perceived quality instrument to assess public and private provider. The result shows that quality and waiting time affect individual's preference to private facility over public. Atella & Debb (2008) and Fabbri & Monfardini (2009) use Italy as a case study to analyze the relation between public and private provider. They highlight different aspect, as the previous paper analyze whether the relation between public and private care is substitute or complementary while the later assesses user charges and waiting time as rationing tools for public provision of health care.

The empirical literature on healthcare demand in developing countries provides several pieces of evidence on effect of price, income, and individual characteristics but none of them directly measured the effect of dual practice existence in the health care system. The theoretical prediction shows that price has a significant role in demand, and the effect is higher in the developing countries because of a higher percentage of low income and limited insurance coverage. Sarma (2009) argues that the demand for health care in developing country has several conflicting evidence. His study finds that price and income are significant determinants of health care demand. The difference results come from the various price mechanisms in the previous studies. Akin, Griffin, Guilkey, &

Popkin (1986) use standard fee schedule while Gertler and Van der Gaag (1989) and Jack (1999) use medical expenditure per visit by the patient. The first approach has been criticized because the price for health care service also depends on type of treatment, quality, and individual health condition. The second measurement suffers as in the data collection process; it might be mixed up with other cost paid by patient such as transportation cost and medicine.

The pattern of health care demand in rural Tanzania by Sahn (2003) shows that the increasing of user fees affect individual to do self-treatment rather than visit public or private health care provider. The quality and availability of doctors or nurses, drugs and clinic environment have considerable effect on health care demand. Study of health care demand during a period of economic depression in Nigeria by Ichoku and Leibbrandt (2003) shows that the severity of illness is the principal reason for people to seek care. It is worth to be noted that none of the papers explicitly mention the implication of dual practice physician in the study.

Dual practice in Indonesia was allowed legally by law in the early 1970s in which one of its goals is to address low salaries among public physician and other health workers (midwife and nurse). Apart from supplementary income for the physician, dual practice is also expected to increase health care supply as health provider has more extended service hours. The improved access to health service in Indonesia is believed to result as a part of dual practice role (Rokx, 2009). Physician ratio in Indonesia is 37 per 100.000 populations although it still has issues on distribution, mainly based on geographical area, between Java-Bali-Sumatera Island and outside Java-Bali-Sumatera Island, or rural and urban areas. Based on Indonesian Family Life Survey wave 5 (IFLS wave 5) in 2014-2015, almost half of general practitioners in public community health center have a private practice. Compare to nearly 70 percent physician in public community health center in the previous IFLS wave (IFLS 4 in 2007); this percentage shows decreasing trend. Results among IFLS wave provides a similar pattern on dual practice: it mostly takes place in urban areas. This description supports the fact that dual practice reacts to demand of health care, where urban area characterizes as more populated area than rural ones.

A limited budget in health care that characterizes most developing countries needs an appropriate policy that will maximize public sector financing and its targeted user (Ensor & Cooper, 2004). Thus, we need a deep understanding of health care seeking behavior regarding the different source of utilization and expenses. Public sector usually has a limitation in facing the growing needs of the population, cost containment subsidizing or levying a retribution for particular treatments, and put priority in some areas regarding geographical obstacles. Knowledge how people behave to seek care can be useful for assessing the feasibility of such efforts: how to deal with the change in health care provider and impact on access to services.

The demand for treatment when an individual has an illness can be translated into provider choice among several different kinds of care, public, private, traditional healer, or no care. This choice is usually related to curative care. The model usually follows empirical specification starting with the behavioral model where an individual maximizes his utility from health and other goods beside medical care. Among several kinds of treatment from a different provider, individual will choose a provider that gives the highest utility under a budget constraint. The utility from health improvement is a function of the available providers to individual and his characteristics. The implication of the model can be focused on how different factors are determining the efficacy of medical care by different providers. These factors can be monetary and non-monetary cost. The price of treatment is typical monetary cost, while travel time and waiting time are some of the non-monetary costs.

Previous studies have explained some explanatory variables in the health care demand function. However, our study is one of the first studies that using a dual practice framework. We treat dual practice indicator, which is percentage of dual practice physician in the area as explanatory variable as a part of facility characterisation to analyse whether this will impact health care demand directly. Demographical characteristics such as age, sex, and education appear mostly as an individual item that can explain demand of health care (Propper, 2000). These features are standard empirical link in health care demand although it is merely vital in health care seeking behaviour between providers. Age and sex are insignificant factors of choice between public and private in Malaria treatment in Brazil (Bartolome & Vosti, 1995). Education level describes how people give a different value for their health and evidence of middle class capture wealth state (Propper, 2000). The reasonable explanation is that utility gained from health care provider might differ according to individual characteristics.

The geographical factors such as rural or urban identification are usually used to accommodate the presumption that different location will have a different kind of health care demand and to refer the health care facilities discrepancy issues between a location that usually happen in developing countries. Income together and price are relevant variables to determine elasticity and to analyse health care demand among income level. These variables usually appear to measure willingness to pay for health care treatment, also to evaluate policy regarding regular treatment fee in the system as one level of income might react differently to others (Jack, 1999).

We construct several testable hypotheses as follows[1]. 1. The percentage of dual practice physician might positively influence patient's choice of health facility. The more dual practice physician is associated with the additional private facility in the area, hence patient prefer to come to private facility rather than to visit public facility or other practice. 2. The insurance ownership affects patients to visit formal health care provider such as public facility and private facility than non-formal provider such as nurse practice, midwife practice, and traditional healer. 3. Income is one of monetary factors that will differentiate the patient's facility choice. Patients with high income will likely to choose private facility and public facility than traditional healer. 4. The price of treatment that also a monetary factor will negatively influence the patient choice to visit any health care facility. 5. The same also goes to non-monetary factors, travel cost and waiting time. The more expensive travel cost to visit particular health care facility will be followed with the decreases in the probability for patients to visit the facility. The longer the waiting time will decrease the patient's interest to visit particular health care facility. 6. The quality aspect will attract patients to visit health care facility. 7. The choice of health care facility

[1] The summary of previous studies that become the foundations of our testable hypotheses is available in Table 3A.1of Appendix 3A

is affected with the geographical identification and individual characteristics such as age, sex, education, and severity illness.

3.3 Health care demand in Indonesia

3.3.1 Indonesia at a Glance

Indonesia is an archipelago country in South East Asia, with almost 13,000 islands and the total area of 1.905 million kilometers squared. Indonesia has around 257 Million populations in 2015; it makes Indonesia the most fourth populous country in the world after China, India, and the United States of America. The Indonesian GDP per capita is 3,834 USD (2015), which is still below the neighborhood countries such as Malaysia and Thailand; however, Indonesia has a promising future of economic power in the region with vast human and natural resources availability. The country has a diversity of more than 1,300 ethnic groups which speaks 2,500 local languages. There are five main islands sorted from the biggest one: Papua, Kalimantan, Sumatera, Sulawesi, and Java. Like many other developing countries, Indonesia faces uneven population distribution where more than half of the population lives in Java Island, and the majority of Indonesia citizen lives in rural areas. The Indonesian economic growth is from 5.02 percent in 2014 to 5.60 percent in 2017 with the five main sectors contributing in Indonesian economy are processing industry, trading, agriculture, construction, and mining.

Indonesia health care system is mostly provided by the public health sector, owned by the government through Ministry of Health. Since decentralization law in 1999, the regional government has controlled and is responsible for the local management including health sector. Although the central government still carries out a regular task such as health care prevention program, most of the medical management is managed by regional government through public health office. There are 6,358 public community health centers that provide outpatient care and 3,396 public community health centers with outpatient-inpatient facility. In terms of ratio, there is one community health center for every 30,000 population. A public hospital provides secondary treatment and constitutes of 60 percent from total 2,488 hospitals in Indonesia. The bed ratio per 1,000 individual in Indonesia shows slight increase from 0.71 in 2011 into 1.21 in 2015.

The public sector implements a referral system for patients who need intensive care for a severe case. In the public health care facility, patients usually visit the public community health center as the front gate of the referral system to get outpatient or inpatient care. Public community health center provides outpatient health care although there are some of them already have inpatient care facility and usually located in the sub-district level. There are also called public community sub center which is the smaller facility of public community health center usually located in the village level. The levels of regional administration in Indonesia from the largest to the smallest are province, regency or city, sub-district and village. The public hospital provides inpatient care and handles the advance case from the public community health center as the higher provider in the referral system. The working hours of public health care facility is limited only during the day and work days but the public hospital usually equipped with the emergency unit for the emergency case. But other than that, patients have to come the next days or to private facility to get immediate treatment. In the private sector, there is no referral system, patient could come and get treatment at any time and any levels. The standard private health care facilities are private physician practice, private clinics and private hospital. The private sector offers flexibility in term of visiting time because private facility mostly opens not only during the day but also in the late afternoon time and night. The private sector usually characterizes with shorter waiting time and promises the better service quality that commonly will be proportional with the treatment fee.

The structure of the primary medical personnel in Indonesia consists of a physician, midwife, and nurse. These three usually provide health care services in public or private facility that provide formal treatment based on modern medical principle. Data from Ministry of Health shows the available physician is 94,727 physicians in 2013 or 38 physicians per 100,000. The number of midwives in the same year is 137,110 or 55 midwives per 100,000 populations. Besides formal treatment, there is a non-formal treatment or alternative treatment where people still rely on in the form of self-treatment or traditional healer. The self-treatment can be consuming over the modern medicine (buying without prescription), consuming traditional herbs, using topical medicine, consuming vitamins and massaging. Based on IFLS wave 5, the percentage of individuals who choose to self-treatment in the period of illness rather than visiting health care facility is relatively high, which is 73 percent. Data from the same resource also shows that, from the total number of patients who visit health care facility during illness period, there is 16 percent still come to a traditional practitioner (shaman, wiseman, kyai, Chinese herbalist, masseur, or acupuncturist). The complete description based on IFLS wave 5 appears in Figure 3.1. The popularity of self-treatment and traditional healer is prevalent not only for low income group but also appear in the highest income group. From the same Figure, the outpatient visit to non-physician facility has high percentage among other facilities, in this case is visit to nurse practice and midwife practice. This indicates that non-physician facility still becomes main option for people seeking care. For the consistency with our research purpose, we divide health care facility into two categories: physician attended facility where physician service is available (public hospital, public community health center, private hospital, and private clinics), and non-physician attended facility where physician service is not available (private midwife practice, private nurse practice, and traditional healer).

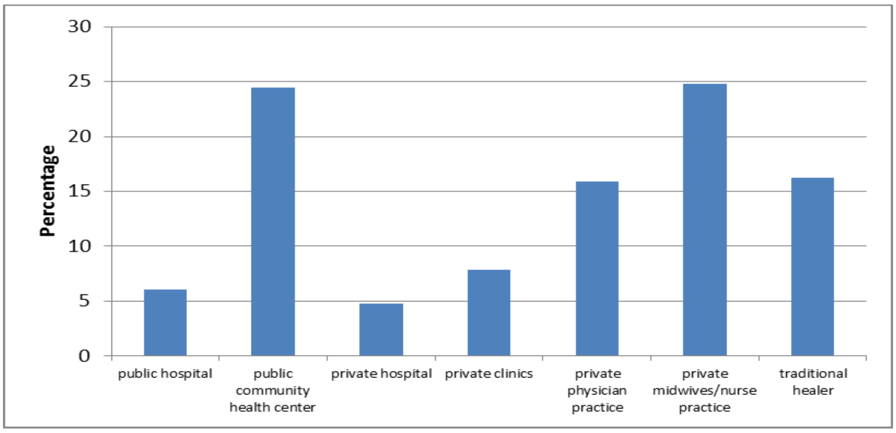

Figure 3. 1 Outpatient care based on health care facility

In general as appears in Figure 3.2, the pattern of seeking health from different waves of IFLS shows that most people seek care into public community health centre, private physician practice, and private midwife or nurse practice. In Indonesian health care system, public community health centre is a front gate of public referral system, also it usually available in each sub-district. The figure also shows the importance role of private sector, not only private practice with the physician but also other midwife and nurse practice. The low level of utilization in public hospital and private hospital is due to smaller number of hospital compared to other health care facilities. The patients usually visit hospital for more advanced case of illness.

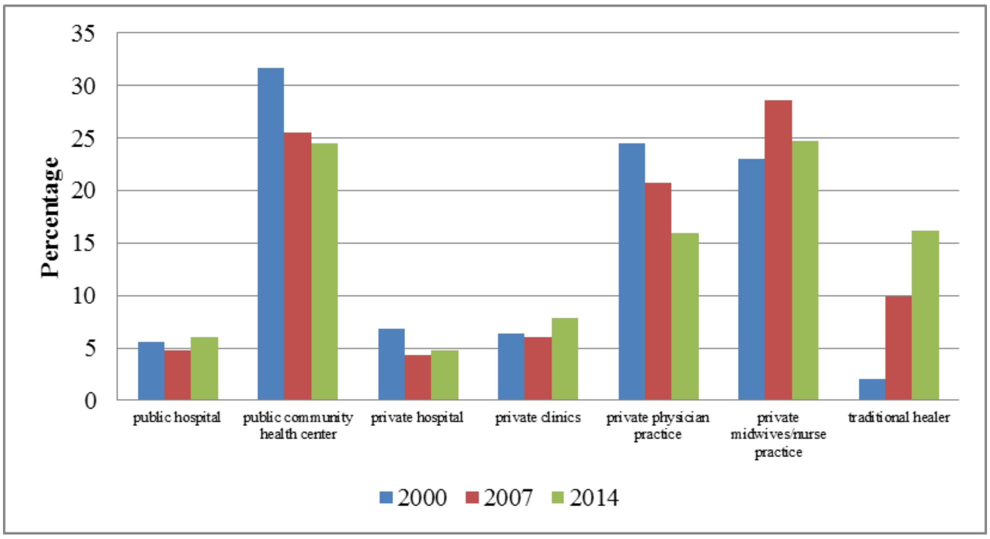

Figure 3. 2 Percentage of outpatient utilization based on IFLS 3, IFLS 4, IFLS 5

The private sector in Indonesia has a significant role in providing health care for the population. The mix health care system in Indonesia allows the private sector to provide service side by side with the public sector. In general, health expenditure as a percentage of GDP is 1.8% in 2014, it shows increasing trend back since 2004, with 1.4%. The out-of-pocket health expenditure (% of private expenditure on health) also shows slightly increasing since 2004 with 73.88% to 75.32% in 2014. In the Figure 3.3, when the public facility is simplified into three categories based on treatment formalities and ownership: public facility, private facility, and traditional healer, midwife, nurse practice, we show the pattern of health seeking care among three categories using three sources of IFLS data from 2000, 2007, and 2014. Rural areas experienced a change in health care seeking pattern from mostly using traditional healer, nurse practice or midwife practice to private clinics or private physician practice. Public facility is the main source in providing health care treatment but private facility such as private clinics and private physician practice is also growing to have important role in providing health care services too. The traditional healer, midwife, nurse practice still becomes a choice for people especially in rural area, while for urban area, people relies more on private facility. Indonesian rural area is commonly characterized with low performance of public facility as its public medical personnel deficiency due to the remoteness and low remuneration among public officer. Rural area usually relies on the private health care facility and traditional healer to meet the need of health care. Although private sector gains more popularity in both urban and rural but in particular, the rural area shows significant increasing in the percentage of individual visit for outpatient care.

The change in healthcare seeking behavior might come from the increasing coverage of health care facility. Based on the Indonesian potential village survey in 2005 and 2014, the number of village having private physician practice is increasing from 11,412 villages in 2005 to 13,781 villages in 2014. While the number of villages with private policlinics center is slightly increasing from 7,223 villages in 2005 to 7,396 villages in 2014. The number of villages with public community health care center and public subsidiary health care center also increase around 15.4% from 30,211 villages that is covered with public community health center and subsidiary health center in 2005 to 34,857 villages in 2014.

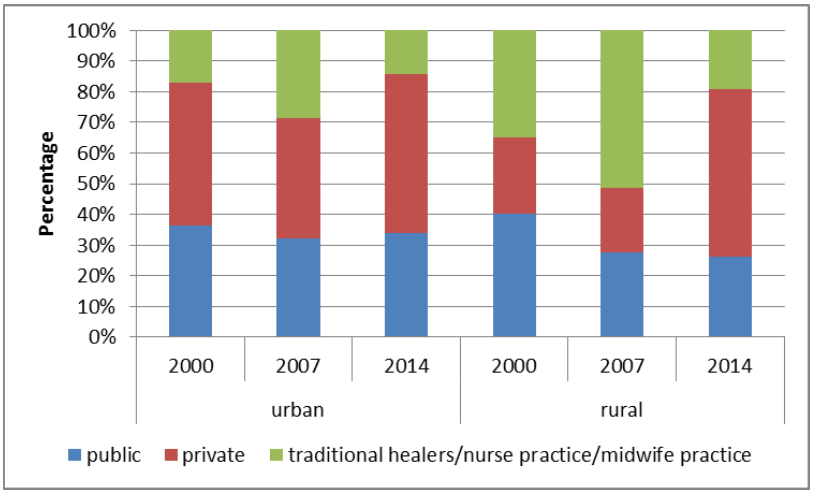

Figure 3. 3 Outpatient care utilization between rural/urban population

Note: The IFLS 2007 has three additional provinces compare to IFLS 2000 while IFLS wave 5 has six additional provinces compare to IFLS 2000. In order to keep the consistency, we only include the 15 provinces as in IFLS 2000 in Figure 3.3: North Sumatra, West Sumatra, Riau, South Sumatra, Lampung, DKI Jakarta, West Java, Center Java, East Java, DI Yogyakarta, Banten, Bali, West Nusa Tenggara, Center Kalimantan, South Kalimantan, and South Sulawesi.

From processing data od IFLS 5, The individual's perceived health status from total sample of 31,421 individuals, there are 13,069 individuals or 42 % of individuals who have at least one day miss their daily activity due to poor health. Among of individuals whom their health are disrupted, only 28% of people visit health care facility. Using morbidity measure, most of individuals or about 85% have one or more symptoms. Among of them who have at least one symptom 20% visit health care facilities. The last measurement on individual's health condition is using chronical condition status. An individual who has at least one or more chronical condition based on medical personnel diagnosed is categorical as in need of health care. There is 33% of individuals in chronic condition, and around 28% of them visit health care facility. To sum up, using three measurements of individual's health condition, around 25% of individuals who were in need of health care treatment visits a health care facility, while the rest of them decide not to seek care in any health care facility.

The different pattern of health care utilization appears between the lowest income quintile and the highest income quintile. Health care utilization between different quintile income shows that the lowest income quintile heavily relies on public community health center and private midwife, or nurse practice. The percentage of individual who visit public community health center is decreasing along with the higher quintile income. The higher is the income quintile, then the higher also the percentage of individual who visit private clinics and private physician practice. The similar pattern also applies on the health care utilization of private hospital. The highest income quintile uses more of a private hospital. It is interesting to be noted that the use of traditional healer is also frequent even in the highest quintile group. The traditional healers are: shaman, wise man, kyai, Chinese herbalist, masseur, and acupuncturist.

The individual in the rural area mostly visits public community health centre while the urban people relies more on private midwife or nurse practice. In comparison, the percentage of individual visit public community health centre between urban and rural area is not much different. The total percentage of an individual visit to private physician practice and private clinics in a rural area is higher than in urban area. This figure confirms the role of private provider to serve the population in the rural area. The discrepancy of health care utilization based on geographic location of island between Java and outside Java Island shows people in Java utilize private facilities (hospital, physician practice, clinics, midwife or nurse) more than individual outside the island. Both areas almost equally utilizing the public community health centre, although Java percentage is slightly higher than Non-Java Island.

We provide description of dual practice physician in Indonesia based on IFLS wave 5 data. On average more than half or 73% of public physicians are dual practice physicians. The number can be interpreted that among 100 public physicians working in public community health centre, 73 physicians are dual practice physicians. Figure 3.4 describe the percentage of dual practice physician in each province that included in IFLS wave 5. The data shows that being dual practice is a common option for public physician who works in public community health centre. They usually have private physician practice after their public working hours. When we differentiate the average percentage based on the island category, provinces in Java Island (in Figure 3.4 are provinces of Jawa Barat, DKI Jakarta, Jawa Timur, DI Yogyakarta, and Banten) in average has a slightly higher percentage of dual practice physician, about 74% compare to provinces of Non-Java Island that has 72%. Data available in IFLS wave 5 only covers dual practice physician in public community health centre.

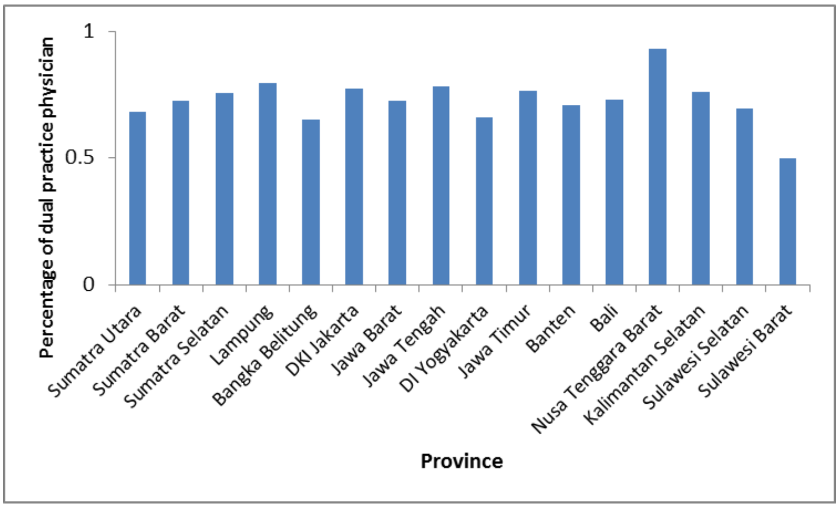

Figure 3. 4 Percentage of dual practice physician based on province in Indonesia, 2014

Related with health insurance using the IFLS wave 5 data, in 2014 half of population or about 53% of population is not covered by any health insurance scheme. Among population with health insurance, there are several insurance schemes in Indonesia. Figure 3.5 shows that most of population with insurance is covered under health insurance by government subsidy from central government or regional government and it is appeared in the graph as Community Health Insurance (JAMKESMAS), Regional Health Insurance (JAMKESDA), Social Health Insurance (JAMKESSOS), Childbirth Health Insurance (JAMPERSAL) and National Health Insurance (JKN). With 63% of coverage, this number shows government commitment to provide health insurance for people particularly from the poor group of income. The program ensures the beneficiaries to get primary and secondary care from public facility using referral system and government will pay the insurance premium. The name differentiation indicates different of financial sources. For example, JAMKESMAS, JAMKESSOS, and JKN are financed by central government, while JAMKESDA is financed by regional government. The JAMKESMAS and JAMKESSOS are the previous subsidized health insurance program for the poor people and since 2014 the central government merges both programs into single platform of JKN. The JAMPERSAL is particular health insurance subsidy that covers childbirth and maternal care. Around 14% of health insurance beneficiaries are covered under health insurance scheme for civil servant. They will pay the premium of 2% from monthly salary. The health insurance also will cover primary and secondary care in public facility. Around 9% of population of insurance beneficiaries are covered under health insurance scheme for formal workers (JAMSOSTEK) and around 10% is covered by employer provided insurance and clinics. Private company in Indonesia has to provide health insurance for its employees under JAMSOSTEK health insurance scheme. But based on the current regulation, they can opt out from JAMSOSTEK and provide their own health insurance scheme by using other private insurance company or providing health clinics for the employees.

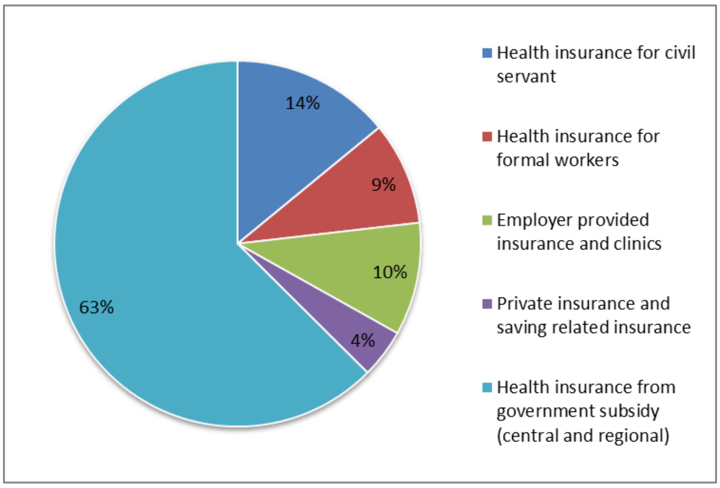

Figure 3. 5 Percentage of health insurance beneficiaries based on the type of health insurance

3.3.2 Data

The Indonesian Family Life Survey (IFLS) is an on-going longitudinal survey in Indonesia. This research uses the recent wave of IFLS wave 5. The IFLS wave 1 to 4 was held in the years of 1993, 1997, 2000, and 2007. The IFLS wave 5 took place in late 2014 and early 2015.The sample in IFLS wave 5 represents 83% of around 237 million Indonesian populations in 33 provinces. The IFLS wave 5 consists of 16,204 households and 50,148 individuals being interviewed. The questionnaire for households covers questions on behaviours and outcomes: wealth of information collected at the individual and household levels, including multiple indicators of economic and non-economic well-being: consumption, income, assets, education, migration, labor market outcomes, marriage, fertility, contraceptive use, health status, use of health care and health insurance, relationships among co-resident and non-resident family members, processes underlying household decision-making, transfers among family members and participation in community activities. The survey also interviewed community facilities in which IFLS households are located and from the facilities that serve residents of those communities. These data cover aspects of the physical and social environment, infrastructure, employment opportunities, food prices, access to health and educational facilities, and the quality and prices of services available at those facilities. The facilities included in the survey are village administration office, school, and health facilities. The large scale of information in one set of the survey makes this data set feasible to use in this empirical study.

The IFLS wave 5 sampling scheme starts with province and urban or rural location stratification. The selected provinces represent population, capture the cultural and socioeconomics diversity of Indonesia, and cost-effective to survey due to the size and geographical location of the country. For primarily cost-effectiveness reason, there are only 13 provinces at the beginning of IFLS1 and increases into 23 provinces in IFLS wave 5. The included provinces based on islands are nine out of ten provinces in Sumatra (Nanggroe Aceh Darussalam, North, West, Riau, Jambi, South, Lampung, Bangka Belitung, and Kepulauan Riau), all six provinces in Java (DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, and Banten), all provinces in Kalimantan (west, center, south, and east), two out of six provinces in Sulawesi (south and west), Bali, West Nusa Tenggara, and west Papua. Among the sample, there are three provinces with only 1 percent sample due to cost effectiveness: Nanggroe Aceh Darussalam, West Kalimantan, and West Papua. Other reason is that IFLS has a specific survey for the eastern area of Indonesia, called IFLS East, that has purpose to collect the similar IFLS information from the eastern Indonesia. The next step is to choose 321 enumeration areas randomly within 13 provinces using sample frame of 1993 socioeconomic survey (SUSENAS). The selection process of enumerating area considers the proportion of urban-rural category and Java Island-non Java Island comparison. The listing of each selected enumerating area uses listing from regional BPS Statistics Indonesia (Indonesia National Statistics) office. From each of enumerating areas, the IFLS selects 20 households from urban enumerating area and 30 households from rural areas. The difference number manages expensive travel cost in the rural areas and maintains the correlation cost among households. The survey defines household as a group of people who live together in the same dwelling and share food from the same kitchen (based on Indonesia National

Statistics definition). Several household members are then randomly selected to do the interview. IFLS interviews following: the household head and his or her spouse; two randomly selected children of the head and spouse age 0 to 14; an individual age 50 or older and his or her spouse, randomly selected from remaining members; for a randomly selected 25% of the households, an individual age 15 to 49 and his or her spouse are randomly selected from remaining members.

The total sample individual in IFLS wave 5 is the total household sample that can be tracked back in IFLS 1minus household member who died between the IFLS waves. Some of the sample might be split from the first household, because of marriage or move to different location, the IFLS will re-contact and track their new location as a part of the sample. The completion rate of the IFLS waves in general is always high; it is around 90 percent and categorized as a successful survey compare to other similar survey in different countries.

Our research uses particular section of IFLS questionnaire in BOOK 1 to calculate the individual income information. The individual income uses household expenditure as income approach. It is a usual agreement among economist that household expenditure is a better estimator than household income to capture household standard of living. This approach is commonly used in developing countries as a good proxy for income (Gertler & Gaag, 1989). Theoretical work by Narayan and Pritchett (1996) shows that in the presence of properly functioning capital markets, expenditure is a better measure of permanent income. The expenditure data sometimes is difficult to assign because being subject to large seasonal swings (Ainsworth & Van der Gaag, 1988; Hentschel &

Lanjouw, 1996; Deaton, 1997) . The estimation process of consumption expenditure is easier because households might consume only certain commodities of goods and services (Hentschel & Lanjouw, 1996). From the field works, households are likely to understate their incomes and overstate their consumption (Deaton, 1997). In our research, the household expenses include all consumption of food and non-food, and cover expenditure for all household members. Expenditure per capita is obtained by dividing total household expenditure with a total household member. The further adjustment is by multiplying the expenditure per capita with the Consumer Price Index for December 2014 from the Indonesia National Statistics office.

The survey of IFLS wave 5 uses the community-facility survey to collect information about communities of household respondents. The official village or township leader and a group of his or her staff were interviewed about community life. The other sources come from health and education facilities. To draw sample of facilities, the survey first defines six strata: Government health centers and subcenters (*puskesmas, puskesmas pembantu*); Private clinics and practitioners including doctors, midwives, nurses, and paramedics (*klinik, praktek umum, perawat, bidan, paramedis, mantri*); Community health posts (*posyandu*); Community health posts for the elderly (*posyandu lansia*); Traditional health practitioners; Elementary schools (*SD*); Junior high schools (*SMP*); Senior high schools (*SMU*) / Senior vocational high schools (*SMK*). The survey wants the detailed interview to reflect facilities available in community from household perspective rather than village leader or on proximity to the community center. The IFLS samples the health facilities based on household information. It is unnecessary for household to use the facilities but more on the household knowledge whether they know those facilities in their neighborhood. For school frame, the survey lists all the schools attended by household members under age 25. The school and health care facilities are excluded from the list if they located more than 45 minutes away by motorcycle from the household residence. The IFLS wave 5 also sets the quota for each facility strata in the enumerating area. Different number facility interviewed is applied, for example private clinics and practitioners has larger sample compare to government health centers and sub centers because Indonesia communities tend to have more private practitioners than government facility.

Our research mainly uses IFLS community questionnaire in health sector: the public community health center and private facility. We measure the quality characteristics and dual practice physician identification from these questionnaires. The dual practice identification using IFLS wave 5 is quite satisfactory because the questionnaire can be used to differentiate which physicians involving in dual practice. Although IFLS data does not have physician information working in hospital but the sample is already represented physicians because most physicians in Indonesia works in primary care facilities such as public community health center and private facilities, which are larger than the number of secondary care such as hospital. The facility of quality is a composite index measured by calculating the score that indicated the cleanness level of the facility, the completeness of the health instruments, and basic medicine storage. The cleanness indicator covers the completeness of cleaning equipment and the result of direct observation on the facility. The quality of physician is measured by the indication whether physician in the facility has got the training related to the expertise such as on the pre-natal care, children care or diabetes care. The quality of treatment is based on the vignette score on the particular case of the treatment. The vignette is a list of questions relates to the example of patient condition. The physicians are being interviewed using questionnaire to get their response on how to manage care based on the symptoms. The result describes the completeness level of care management that ideally should be done to treat the case.

3.4 Empirical Strategy and Estimator

3.4.1 Dual practice and factors affected demand of health care

The general framework of how dual practice physician activity affected individual decision on health care facility choice starts from a health care demand function. Individuals make decision on medical care when the illness period occurs. The decision is a complicated process as this decision might be influenced by other individuals or professional advice, individual considers risk and benefit when choosing a particular medical care, and the potential opportunity that will be sacrificed because using financial resource on medical care instead of other goods. The economic model of determining health care demand in this research follows a conventional utility theory that considers health as one of the several commodities where individuals have knowledge on individual preference. The demand of health care service can be described using an orthodox static-utility maximizing framework (Phelps,1992). Individuals have preference on health. They use health care services as input to produce a health. The level of health care services adjusts with the individual level on preference of health. This preference is independent of health status and health care demands change based on the illness period where the medical services could improve health.

Different econometric techniques are needed when dealing the different nature of dependent variables characterize health care demand. The discrete choice model is preferred in this research as an individual will decide which facility he wishes. We estimate the probabilities of choosing health care facility conditional on patients have already opted to get treatment from health care facility and not preferred on self-treatment. The dual practice physician means the availability of health care services in the system. It describes the supply situation that will affect individual's decision. We expect that the more dual practice physicians in the areas, the individuals will show different reactions. Our empirical strategy will provide evidence on the relationship between dual practice physicians and demand of health care and also define the magnitude of the relationship.

Our research frames the patient's decision that after patient decides to seek care, he will choose a particular health care. The available options for the patient are going to public facility, private facility, or other. The latter refers to health care facilities without attended by physicians which in our case are nurse practice, midwife practice, and traditional healer. Consider our model has three outcomes equal to $\{1, 2, 3\}$ that describe dependent variable y as individual choice to private facility $(y = 1)$, public facility $(y = 2)$, or others $(y = 3)$. We provide the summary of the code and the resources from the IFLS questionnaire to describe clearly the link between the model and the available data. The data appears in Table 3.1.

Table 3. 1 Code for the dependent variables in individual choice of health café facility model

Facility	Code	Original code from IFLS Questionnaire*	Physician/Dual practice physician attendance
(1)	(2)	(3)	(4)
Private facility	1	**E.** Private hospital*** **F**. Polyclinic, Private Clinic, Medical Center **G**.Private Physician (General Practitioner, Specialist, Dentist, Family Doctor)	Yes
Public facility	2	**A.** Public hospital*** **B**.Public Health Center (puskesmas)/Auxiliary Center (puskesmas pembantu)	Yes
Other facility**	3	**H**. Nurse, Paramedic, Midwife practitioner **I**.Traditional practitioner (shaman, wiseman, kyai, Chinese herbalist, masseur, acupuncturist, etc.)	No

*The bold letter indicates the original code for the alternatives answer in IFLS Questionnaire.
**We also refers this category as non-physician category, as there is no physician attendance in the facility
***Although we include the hospital option, we should note that the limit of the study is the outpatient care only. The facilities refer to the outpatient clinics that are managed by hospital.

Patient's decision will depend on several factors. The explanatory variables, including the dual practice existence that we want to measure its effect on health care demand are represented in *X*. The definitions of dependent variables are summarized in Table 3.1. The structure of the outcomes are not in ordered, as selecting private facility does not imply that private facility has larger or smaller outcomes than selecting public or other facility. We estimate a set of coefficients $\beta^{(1)}, \beta^{(2)}, \beta^{(3)}$ based on the outcomes[2]:

$$\Pr(y = i) = \frac{e^{X\beta^{(i)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}}, for\ i = 1,2,3. \qquad \textbf{(3. 1))}$$

[2] Following Hosmer, Lemeshow, & Sturdivant (2013) with appropriate adjustment with our study purpose.

To identify the model, we set $\beta^{(2)} = 0$ and the outcome *y*=2, (visit to public facility) is the reference group. The $\beta^{(1)}$ and $\beta^{(3)}$ measure the change relative to the *y*=2 group. The different coefficients will be used to identify how explanatory variables affected the health care demand. Setting $\beta^{(2)} = 0$, the equation becomes:

$$\Pr(y=2) = \frac{1}{1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}}$$

$$\Pr(y=1) = \frac{e^{X\beta^{(1)}}}{1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}}$$

$$\Pr(y=3) = \frac{e^{X\beta^{(3)}}}{1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \qquad \textbf{(3. 2)}$$

The relative probability of *y*=1,3 to the reference category of $\mathrm{y} = 2$ is then:

$$\frac{\Pr(y=1)}{\Pr(y=2)} = e^{X\beta^{(1)}}$$

$$\frac{\Pr(y=3)}{\Pr(y=2)} = e^{X\beta^{(3)}} \qquad \textbf{(3. 3)}$$

Assume that *X*, $\beta^{(1)}$, $\beta^{(3)}$ are the vectors correspond to

$(x_1, \ldots, x_k)$,$\left(\beta_1^{(1)}, \ldots, \beta_k^{(1)}\right)'$, $\left(\beta_1^{(3)}, \ldots, \beta_k^{(3)}\right)'$. The relative risk ratio for one unit change corresponding variable is the exponential value of:

$$\frac{e^{\beta_1^{(1)}x_1+\cdots+\beta_i^{(1)}(x_i+1)+\cdots+\beta_k^{(1)}x_k}}{e^{\beta_1^{(1)}x_1+\cdots+\beta_i^{(1)}x_i+\cdots+\beta_k^{(1)}x_k}} = e^{\beta_i^{(1)}}; \frac{e^{\beta_1^{(3)}x_1+\cdots+\beta_i^{(3)}(x_i+1)+\cdots+\beta_k^{(3)}x_k}}{e^{\beta_1^{(3)}x_1+\cdots+\beta_i^{(3)}x_i+\cdots+\beta_k^{(3)}x_k}} = e^{\beta_i^{(3)}} \qquad \textbf{(3. 4)}$$

Using multinomial logistic model for our model is a straightforward process in depicting factors affected demand of health care; moreover our point of interest is mainly in the dual practice existence that influences individual decision on health care facility. Besides providing more straightforward interpretation on the result, multinomial logit has a standard feature that becomes primary concern in the research. The model should satisfy the Independence of Irrelevant Alternatives (IIA) assumption. Domencich and McFadden (1975) mentioned that the error terms should be independently distributed and the addition of a new alternative while decreasing the probability that an alternative is chosen does not alter the relative odds of the existing ones. It means that the addition of facilities in the outcomes should not change the current relative odds. The assumption usually entails that the outcomes should be distinctive so that the use of multinomial logit is appropriate. In most of studies, Amemiya (1981) mentioned that the IIA assumption should be carefully justified. The outcomes of this study in practice can be differentiated based on the type of provider. Each facility has its own characteristics. The private facility is owned by private individuals and usually is characterized by better quality and higher price compared to public facility. In other hand, the public facility is facility owned by government that usually provide standard health care services in term of quality and treatment fee. The last category provides the non-physician facility (midwife practice, nurse practice, and traditional healer). The first two facilities might have the similarity in the kind of services available and that those facilities are attended by physicians while the last outcome category; we can say it is reasonably different. The estimation process will be completed with the testing of IIA assumption in the first place, so that result from the multinomial logit approach can be accounted for.

The model is summarized as a system of demand equations:

$$Q_{ij} = f_{ij}(D_j, Y_j, P_j, T_j, Z_j) \qquad \textbf{(3. 5)}$$

Where

Q_{ij}= whether outpatient medical service i is used by the j th individual, where

i = private facility, public facility, or traditional healer/midwife/nurse practice

j = all individual age 15 or above who decides to seek care during the period of illness in the last 4 weeks prior the survey.

D_j= percentage of dual practice physician in the public facility where individual lives.

Y_j= monthly income for the j th individual.

P_j= price of service paid by j th individual.

T_j= vector of non-monetary factors associated with distance and waiting time by each j th individual.

Z_j= a vector of social and demographic control variables for the j th individual.

The D_j, Y_j, P_j, T_j, Z_j are the independent variables that appears as X in the beginning when we define the model.

In our model of individual choice of health care facility, we have insurance as one of the explanatory variable. Dor & Umapathi (2014) mentioned three causes related with methodological challenge when the study involves insurance and health outcomes:

selection, reverse causality and omitted variables. The selection problem arise when there is asymetric information between insures and insured. The estimate relationship between insurance and health will bias downward. The adverse selection appears when insurance company attracts sick people who more likely to use insurance benefit and health people will choose cheaper insurance plan. The reverse causality appears when health affect health insurance status and the direction of bias is still unknown. Lastly, the ommited variable bias is resulted when individual’s choice of insurance are affected by some factors that also affects the health outcomes but these factors are not observed by researcher. For example, risk-averse people avoids the risk of income loss from buying the insurance but on the other hand they show risk-avoid health behaviours. Risk aversion variable is rarely available in the data set. As a consequence the explanatory variables included in the regression might be correlated with the error term. Our study might suffered the endogeneity from the last cause. Most of the observations are not engage in any of the insurance schemes while most of people who are using the insurance are holding the insurance susidized from the government.

We address the endogeneity problem in individual choice of health care facility model by carefully examining an instrumental variable based approach to correct the endogeneity bias. The focus here is to use proper tool to analyze our case where the model is generalized linear model with binary endogenous variable. The method has been referred as two-stage residuals inclusion (2SRI) (Terza, Basu, & Rathouz, 2008). It is an extension to non-linear model of usual two-stage least square estimator (2SLS). On the first stage, the reduced form regression is estimated and the results are used to generate predicted values for the endogenous variable. The second stage regression is conducted for the outcome equation of interest but instead of replacing the endogenous variable with its predicted value like in the two-stage predictor substitution (2SPS), the 2SRI uses the residual and the actual observed value of the endogenous regressors are still maintained.

In our empirical model, the individual choice is conditional on the insurance ownership because the individual wants to go to a certain health care facility then he chooses the insurance contract that allows it. Therefore we allow for the possible endogeneity of individual's having insurance in the choice of health facility. The conditional mean of individual choice of health facility is[3],

$$E(y|x_e, x_o, x_u) = M(x_e\beta_e + x_o\beta_o + x_u\beta_u) \qquad \textbf{(3. 6)}$$

Where y is the choice of health facility outcome, $M(.)$ is a known function, and there are three types of explanatory variables in our model: x_e is a $1 * J$ vector of binary endogenous insurance variable, x_o is a $1 * K$ vector of observable exogenous explanatory variables; x_u is a $1 * J$ vector of unobservable explanatory variables that have an impact on the choice of health facility and are also correlated with the endogenous variable of insurance. The regression model for the choice of health care facility is:

$$y = M(x_e\beta_e + x_o\beta_o + x_u\beta_u) + e \qquad \textbf{(3. 7)}$$

The e is the random error and it is assumed that $E(e|x_e, x_o, x_u) = 0$. The estimates of above equation will be biased and inconsistent if the insurance ownership is endogenous.

[3] We follow the work of (Terza, Basu, & Rathouz, 2008) and (Nguyen & Connelly, 2014) with adaptation of our particular case.

We resolve this issue using an instrumental variables approach by introducing reduced regression for the insurance ownership.

$$x_e = r(w\gamma_j) + x_{uj} \; for \; j = \overline{1, J} \quad \textbf{(3. 8)}$$

Where $w = [x_o + z], z \; is \; a \; 1 \geq H$ vector of instruments$(H \geq J)$, and γ_j is a $(K + H) * 1$ vector of parameters. The instrument variables of z must fulfill the following conditions: (1) they cannot be correlated withx_u; (2) they must sufficiently correlated with x_e; (3) they cannot be correlated with the variable of y, unless through x_e only. Insurance ownership is a binary choice which indicates individual using insurance or not using insurance. We use the Probit model to model insurance variable. The individual choice outcome in our case is whether respondent visited one of the health care facilities: dual practice facility, public facility, or private facility in his last visit in a month prior to survey. Individual chooses one of three mutually exclusive states therefore we estimate the individual choice via Multinomial Logit model. The correlation between error terms in insurance and individual choice of health care facility will be addressed using 2SRI approach. It gives consisten estimates for the individual choice of health care facility with endogenous explanatory variable where both outcome and endogenous variables are modelled via non-linear regression (Terza, Basu, & Rathouz, 2008). The result of SRI approach is available in the Appendix.

The 2SRI approach is first proposed by Hausman (1978) to test the endogeneity in the model (equation 3.7 and equation 3.7). The 2SRI is identical to 2SLS, so that β_e and β_o are consistent. The 2SRI provides a consistent estimate for β_u in linear case. Previous literatures show that 2SRI is consistent for specific non-linear models for example Nguyen & Connelly (2014) emphasize the endogeneity of unpaid caregiving intensity when analyzing its impact on the labor force participation of caregivers. Study by Shea, Terza, Stuart, & Briesacher (2007) identify the impact of insurance coverage to prescription utilization by Medicare beneficiaries. Some other studies that employed 2SRI in health economics field are: Shin & Moon(2009) , Stuart, Doshi, & Terza (2009), Lindrooth & Weisbrod(2007).

The challenge in using instrument variabel approach is finding a good instrumental variable for endogenous variable, in this case is variable of insurance. We use self-employment to explain insurance usage in our model. The self-employment is indicated as a good instrument in (Meer & Rosen, 2004). There is a strong negative relationship between insurance and self-employed (Perry & Rosen, 2001). We use the self employment as the instrumental variable for insurance, and also use the marital status for the comparison.

Dependent variable: visit private facility, public facility, or other facility

The dependent variable is a categorical variable that identifies individual visits to one among health care facilities of private practice, public facility or other facility. The latter refers to traditional healers, nurse, and midwife practices. The provider choice in this variable is specific for the last visit in the last four weeks prior survey. We simplify individual's choice on health care facility in IFLS data for our research purpose[4]. The result of options classification appears in Table 3.1 above. We reclassify from seven categories of health care facility choices into three categories: private facility, public facility, and other. The public facility consists of public hospital and public community health centre. The private facility covers polyclinic, private clinic, medical centre; private physician (general practitioner, specialist, and dentist) and the private hospital. The study focuses on the outpatient care by considering the data availability and more frequent case in order to ease the capturing information. The outpatient care can describe more precisely on the choice of health facility made by the patient rather than inpatient care that usually related with the medical decision. The third category is the other category or non-physician facility; here we categorized practice by nurse, paramedic, and midwife together with traditional healer. As our primary concern of the study is on physician, the third category covers all kind of practice other than physician or medical doctor. We only consider first visit patient-initiated to exclude bias from previous visits that might be influenced by physicians and other previous experience in the specific provider.

Percentage of dual practice physician (DP)

This variable identifies the percentage of dual practice physician available in the area where patient live. The identification of dual practice activity can be tracked down in the public community health centre questionnaire. The physicians will be listed and declare the activities outside the public practice. We calculate the percentage of the dual practice

[4] The information in the questionnaire contains seven facility categories: public hospital; public health centre; private hospital; polyclinic, private clinic, medical centre; private physician (general practitioner, specialist, and dentist), nurse, paramedic, midwife practitioner; traditional practitioner (shaman, wise man, kyai, Chinese herbalist, masseur, acupuncturists, etc.)

physician by dividing the number of physician who involve in dual practice with the total physicians in the facility. The dual practice identification is not available from the private facility questionnaire because the survey has a slightly different approach to get data from the private facility. The interview process is only for facility representative that might be a physician or not (receptionist, nurse or midwife). If facility representative is a physician, then we can detect whether he is a dual practitioner or not. Otherwise, this facility cannot be identified to have dual practice physician. This limitation forces us to concentrate on the dual practice physician identified from the public facility with the consideration that the response rate for the public community health centre is high, almost 100 percent while the response rate of private facility for this particular dual practice identification is low. The dual practice variable in this research refers to the average ratio of dual practice physician in province level. Thus it is measured an average effect of existence of dual practice, not whether a patient goes to a dual practice facility or not. Patient's visit to health care facility might be affected by different situation of treatment capacity in the system. Patients may not consider the existence of dual practice physician directly from this measurement, the same argument may apply when we use the variable indicating whether patient visits dual practice facility or not. But the important thing is that patients will observe the change of treatment capacity caused by this practice. So that our data definition will be sufficient to measure the effect of dual practice physician on the patient's decision of health care facility.

Income

Income is measured using personal consumption expenditure. The expenditures cover expenditure on food consumption from the food staple to prepared food and tobacco. The expenditure also counts the non-food expenditure that consists of electricity bills, water, clothing, schooling, medical costs and non-food items given to other parties outside the households. The calculation considers all items being consumed not only from purchasing activity but also from items given by other parties. Some expenditure captured in different time frame, such as the clothing expenditure and schooling expenditure are measured in yearly, the electricity bill is counted in monthly and the food consumption is calculated in weekly. We equalize all time frames into monthly by dividing twelve of yearly information and multiplied by four for the weekly information. The summation of food and non-food expenditures then will be divided with total number of household. The result also adjusted with the Consumer Price Index (CPI). The final figure is the individual monthly income approximated from the personal monthly expenditure using currency of Indonesian Rupiah (IDR).

Price

We use the treatment fee when individuals visiting health care facility as proxy to the price of treatment in each facility. This is due to the lack of information of price information from facility that categorized as other facility (nurse practice, midwife practice, and traditional healers). The public facility and private facility have the same information of the price based on the kind of health care services but the other facility (nurse practice, midwife practice, and traditional healer) has different kind of services hence it does not provide the same information as the other two facilities. Therefore we use treatment fee paid by patients when visiting health care facility as a source of price information. As a comparison, we will use the treatment fee as a proxy of treatment price without estimation process in the Appendix. The difference is that the price cannot appeared as price per sector but it will reflect the price of treatment in general term.

The approach to retrieve price information is using the amount of money in Indonesian Rupiah (IDR) from individual's out of pocket to pay the outpatient treatment in health care facility. The amount of money paid to health facility varies usually based on kind of treatments and providers. The imputation process is needed to complete the price information per sector for each individual. We use the average treatment fee based on providers and administration areas (village, sub-district, regency, and province) characteristics. We use this information as a proxy for the price of treatment in health care facility although it contains the heterogeneity not only from different provider but also from a different kind of treatment. From the point of view of individuals they see a price is not differentiated based on the facility to visit but what matter is the price paid by the patient.

The process starts with checking all entries of the treatment fee for each individual in the sample from missing values code. We calculate the average of treatment fee for individuals visiting the same kind of facility in the same area. Each individual will have complete set of price information for price in public, private or other facility. For example, Individual A visits private facility in the area X and pays treatment fee as a price in the private facility. From the data, we only get the information of the treatment fee of visiting private facility but no information about the alternative price if this Individual A visits public facility or other facility. We fill the information of public price and other facility price from other individuals live in the same area (area X) with individual A but choose to visit public or other facility. The area identification is stratified from the lowest identification level of sub-district, region, and province. At the end of the process, we will have a complete set of price information for individual A that is approximate from the treatment fee of health care facility.

Demographic variables

Age is a continuous variable that determines the demand for health care in general. This variable is one of the individual characteristics to explain individual choice among provider. The IFLS wave 5 data in health section provides only for adult 15 years or more. The rationale behind age restriction is that children have a different demand of health care compare to adult. Their decision of seeking care also is determined by their parents or household head.

The male variable is coded one if the individual is male and zero for the female individual. In general, the sex difference also believed to have a different demand of health care. In our model of provider's choice, we put this variable as one of the demographic characteristics that might show a different pattern of a provider seeking behaviour based on gender.

Education level is also an essential determinant of determining health care provider. The more educated person might have a healthier lifestyle and get more informed on health care facilities available. Health care knowledge leads to the likelihood of people visit to more modern facility in this case is public or private rather than traditional healer. Education variable in this research is a level of education that was coded into five categories: never attend school, primary, secondary, high school, and higher education levels. The never attend school is the base category. We expect a positive relation between education level and public or private health care utilization.

Insurance

The insurance variable is coded one if the individual use any insurance in his last visit to health care facility and zero otherwise. There are several insurance scheme in Indonesia, such as public insurance that usually for civil servant and the poor: ASKES, SKTM, JAMKESMAS, JAMKESDA, JKN, JAMPERSAL; and private insurance: JAMSOSTEK, employer provided health benefits, private health insurance, and savings related insurance. Insurance ownership in Indonesia is quite low and increased drastically into more than half of total population since the program of health insurance for the poor has launched in 2007.

Severity

Health condition is an individual characteristic that important influence individual to seek care. Several variables can be used to describe health status among individuals, such as a number of illness, chronic condition, or symptoms. After trying and analysing the use of three approaches, we decide to use the number of days with any illness. The variable of severity was measured as days when a person is experiencing health problems and activities disrupted because of illness in 4 weeks before the survey. There is no further explanation from the questionnaire that relates one episode of sickness with the provider he visits. We only can identify that disease and episode and health care visit happen in the same period.

In order to distinguish health care demand geographicaly, we use a binary variable to identify whether the individual lives in urban areas (1) or zero otherwise. The other category is the island classification. The variable is coded one if an individual lives in Java Island and 0 otherwise.

Non-treatment cost

Travel cost is used to approximate distance to health care facility. This variable is using a money unit in Indonesia Rupiahs (IDR) that individual spends in the last visit to a health facility, including fuel cost in one way trip. We differentiate the travel cost based on facility category: travel cost to private facility, travel cost to public facility and travel cost to health care facility categorized in other. We calculate the median of travel cost from the same administrative area for the particular provider. This variable also describes personal knowledge of other providers available in the neighbourhood. We assume that individuals will visit providers around their neighbourhood for most of the cases.

The waiting time indicates how long individual expected to be examined in health care facility upon arrival. The measurement unit is in minutes. The waiting time also applies for each facility category, private facility, public facility, and facility in other category. The value of waiting time in public is individual waiting time who visits a public health facility. We calculate the median value of waiting time in a public facility in the same administration area under assumption that individual in the same area will experience the same amount of waiting time for a particular category. The same calculation applies for the waiting time of private facility and other facility. We summarize all variables that involve in the model in Table 3.2.

Table 3. 2 List of variables names and definition for individual choice of health care facility model

Variable name	Definition
(1)	(2)
Dependent variable	Individual visit to health care facility prior 4 weeks of the survey: 1. Private facility 2. Public facility 3. Other facility Based category: public facility (3)
Dual practice	The average of dual practice physician ratio in public facility at a province level.
Age	The squared age of individual.
Male	1. Male; 0. Female
Education	Education level: no education, elementary school, junior high school, high school, higher education.
Insurance	Using insurance during the visit: 1. Yes 0.No
Income	The average monthly income per person (IDR)
Severity	The severity level (Score)
Urban	Living in 1. Urban, 0. Rural
Java	Living in 1.Java island,0. Non-Java island
Travel cost to private facility*	The total transportation cost to the private facility (including fuel cost, one way trip in IDR)
Travel cost to public facility*	The total transportation cost to the public facility (including fuel cost, one way trip in IDR)
Travel cost to other* facility	The total transportation cost to the other facility (including fuel cost, one way trip in IDR)
Waiting time in private facility	How long to wait to be examined upon arrival in the private health care facility (minutes).
Waiting time in public facility	How long to wait to be examined upon arrival in the public health care facility (minutes).
Waiting time in other facility	How long to wait to be examined upon arrival in the other health care facility (minutes).
Price in the private facility*	The average price of a particular treatment in private health care facility at village level.
Price in the public facility*	The average price of a particular treatment in public health care facility at village level.
Price in the other facility*	The average price of a particular treatment in other health care facility at village level.

*Use the unit currency of 10,000 IDR

Self-employment is binary variable where one indicates that individual is self-employed, and 0 for others. This variable is extracted from variable item number TK24 in IFLS 2014 questionnaire indicates whether individual status in his primary job (job that consumes most time) is self-employed, self-employed with unpaid family worker/temporary worker, or self-employed with permanent worker, government worker, private worker, casual worker in agriculture, casual worker not in agriculture, or unpaid family worker. We re-categorize the variable by grouping the first three options into code 1 which is individual is self-employed, while the rest is categorized as 0 (other). In the last category also includes people who are not working in the present time of the survey.

3.4.2 Quality and demand of health care

In this sub section, we will provide an analysis on how quality aspect influences health care demand. This is an additional benefit from using the same data source of IFLS wave 5 as the data is completed with the information on quality. We measure specifically the role of facility quality on the demand of health care after controlling other variables and conditional on individual decide to seek care in the formal health care facility. The formal care refers to the facility which is attended by physician. The demand for health care is stated as whether individual visits public or private health care facilities during one period of illness prior four weeks of the survey. The model also simplified only in one level of decision making by individual based on the first visit to health care provider.

In this research, the demand for health care of individual chooses public or private provider is a dichotomous variable. It takes the value of one ($y_d = 1$) with probability π

if the patient has demand of health care in private practice and zero ($y_d = 0$) with probability $1 - \pi$ if individual has no demand in private. The binary outcome is related with the available data on quality aspect that will be our focal point for the model. The quality data is collected from the public community health centre questionnaire and private practice facility questionnaire. These two questionnaire have equal quality structure hence it is possible to compare individual's choice between public or private facility. We excluded the non-physician practice (midwife, nurse, and traditional healer) as the facility has different quality information structure hence incomparable with the other two choices.

The quality aspect in this research represents the quality aspects mentioned in (Phelps, 1992) that quality is defined into two components; the first is quality related with the production of health such as physician training or technology. The second component is quality related with the amenities aspect of health care such as convenience of opening hours and friendliness of service. Adopting the quality framework, we have three aspects of quality: quality of physician, quality of treatment, and quality of facility. The other explanatory variables that determine health care demand is the same structure as previous model: dual practice, monetary, non-monetary, and individual characteristics.

The demand of health care can be described as individuals visit into private facility or public facility. With only two outcomes, for the convenience we code the response variable as:

$$y_i = \begin{cases} 1 \ if\ the\ i-th\ individual\ visits\ a\ private\ facility \\ 0\ \ otherwise \end{cases}$$

Table 3. 3 Code for the dependent variable in individual choice of health care facility with quality factor

Facility	Code	Original code from IFLS Questionnaire*
(1)	(2)	(3)
Private facility	0	**E.** Private hospital **F**. Polyclinic, Private Clinic, Medical Center **G**.Private Physician (General Practitioner, Specialist, Dentist, Family Doctor)
Public facility	1	**A.** Public hospital **B**.Public Health Center (puskesmas)/Auxiliary Center (puskesmas pembantu)

*The bold letter indicates the original code for the alternatives answer in IFLS Questionnaire.

**Although we include the hospital option, we should note that the limit of the study is the outpatient care only. The facilities refer to the outpatient clinics that are managed by hospital.

The y_i is a realization of random variable Y_i which take value of one and zero with probabilities π_i and $1-\pi_i$. Suppose we have k independent observations $y_1, \dots, y_k$ and y_i has a binomial distribution,

$$Y_i \sim B(n_i, \pi_i)$$

The $n_i = 1$ for all i that shows the stochastic structure of the model. The linear function of predictors with logit of the probability $\pi_i$is

$$logit\ (\pi_i) = x_i'\beta,$$

the x_i a vector of covariates and β is a vector of regression coefficient. The model structure is generalized linear model with binomial response and link logit function. Taking the exponential value to get the odds of i-th individual,

$$\frac{\pi_i}{1-\pi_i} = exp\{x_i{}'\beta\}$$

The multiplicative form above is useful to calculate the odds ratio when we are interested in one unit change of the j-th predictors while holding other things constant, we multiply the odds $exp\{\beta\}$. The interpretation in term of odds ratio will be easier as it presented in more familiar scale. The model is summarized below in reduced form, as a system of demand equations. Here we decompose the explanatory variable of x into several definitions to make vivid interpretations of the results.

$$Q_{ij} = f_{ij}\left(D_j, Y_j, p_{pv_j}, p_{pub_j}, t_{pv_j}, t_{pub_j}, Z_j, q_{pv_j}, q_{pub_j}\right)$$

Where

Q_{ij}= whether outpatient medical service i is used by the j th individual, where

i = private facility or public facility

j = all individual age 14 or above who decides to seek care during the period of illness in the last 4 weeks prior the survey.

D_j= percentage of dual practice physician in the public facility where individual lives.

Y_j= monthly income for the j th individual.

P_j= Price of service paid by j th individual.

$\boldsymbol{t}$ = vector of non-monetary factors associated with distance and waiting time by each j th individual.

$\boldsymbol{Z_j}$ = a vector of social and demographic control variables for the j th individual.

q = vector of facility-level quality including quality of facility, physician's quality and treatment

quality

$\boldsymbol{q}_{pv_j}$ = quality of private facility serving the j th individual's area.

$\boldsymbol{q}_{pv_j}$ = quality of public facility serving the j th individual's area.

The estimation process in health care demand function is using logistic regression technique as it uses a dichotomous variable. This regression cannot be estimated using ordinary least squares because it suffers from heteroscedasticity and non-normality problem in the error term. We use Maximum Likelihood Method to estimate parameters of logistic regression.

Dependent variable: visit private facility, public facility, or other facility

The dependent variable in the quality regression will only consist of two options: individual visits private practice or individual choose to public facility. We exclude the traditional healer, nurse, and a midwife practice out of the sample because the facility information corresponds to the patient visit is limited only to the public community health centre and private facility. The latter consists only the polyclinic, private clinic, medical centre; private physician (general practitioner, specialist, and dentist).

Price

Different information sources are used to get the information price for public and private facility. We get the price information by matching the individual information with the health facility being visited. The information comes from public community health centre questionnaire and private health cfacility questionnaire. The price of particular treatment measured in Indonesian Rupiahs (IDR). This information is a part of provider's characteristics and suffered from considerable missing values because some of the health care facilities were not filling in their price of treatment questionnaire. The imputation process applies by replacing with a median of price based on providers and administration areas. We assumed that price for treatment in the same kind of providers and areas would be similar. We use two kinds of prices that mostly available in the facilities: the price of treating wound and price for examination and medicine as a proxy of price in public and private facilities. The use of particular treatment price as a proxy for the price suffers from the assumption that not all individuals visit health facility to get that treatment. However, we can argue that the variation in the price hence based only because of provider differentiation.

Quality of facility

The quality of the facility is a dummy variable relates to the cleanness of facility in the examination room and the availability of cleanness tools such as trash bin and wash basin. Interviewer observes the cleanness facility during an interview session in the facility. This variable can be used as a proxy for provider quality from user's perspective. The detailed composition of quality facility index is available in Appendix 3C. The quality of facility also covers completeness of necessary equipment and medical supply in the facility.

These questions are filled by the provider's staff. We calculate the average of facility quality by sum up the score of quality and divided by number of facilities in province level for public and private category.

Quality of physician

The quality of physician has measured whether a physician in the facility gets additional training after graduating from medical school. There are trainings related to specific ability captured by IFLS wave 5 questionnaire, but in this research, we do not specify any particular ability and take general definition whether physician get any additional treatment. The quality of physician is a ratio between a number of physicians with additional training and total physician in a facility at province level. First, we identify the total number of physician and number of physician who received training in one facility. Then we take the average for public and private category at province level.

Quality of treatment

The quality of treatment is a score of physician vignette in curative care for an adult. The vignette contains a list of questions in how the physician is diagnosing patient's case. The full set of the vignette questions are available in Appendix 3C. The valuation is not based on true or false but how physician will react spontaneously to provide general procedures in diagnosing patient's symptoms using dummy case. The ideal expected score should be a low score because a spontaneous respond is coded 1 while prompted responds are coded 2 and 3. The small score indicates that physician has already applied appropriate procedure. There are four kinds of vignette in the questionnaire: curative care for adult, curative care for an adult with diabetes, curative care for children, and prenatal care. We use only the curative care for an adult as this treatment mostly available in public and private facilities. The vignette questionnaire can be filled by other medical staff such as midwives or nurses, but in this study, we consider the only vignette that is occupied by a physician. We take the average vignette score for each category: public and private at province level. All variables for the quality effect are summarized in Table 3.4.

Table 3. 4 List of variables names and definition for the individual choice of health care facility with quality effect

Variable name	Definition
(1)	(2)
Dependent variable	Individual visit to health care facility prior 4 weeks of the survey: 0. Private 1. Public Reference category: public facility(1)
Dual practice	The average of dual practice physician ratio in public facility at a province level.
Age2	The squared age of individual.
Male	1.Male; 0. Female
Education	Education level: no education, elementary school, junior high school, high school, higher education.
Insurance	Using insurance during the visit: 1. Yes 0.No
Income	The average monthly income per person (IDR)
Severity	The severity level (Score)
Urban	Living in 1. Urban, 0. Rural
Java	Living in 1.Java island,0. Non-Java island
Travel cost	The total transportation cost to the facility (including fuel cost, one way trip in currency unit of Indonesian Rupiahs, IDR)
Waiting	How long to wait to be examined upon arrival in the health care facility (minutes).
Price	The average price of a particular treatment (treating a wound) in private health care facility at province level.
Quality facility	The average score of public facility at province level.
Quality physician	The average of ratio between a number of physicians with additional training and total physician in public facility at province level.
Quality treatment	The average of vignette score of public facility at province level.

3.5 Descriptive Statistics

3.5.1 Sample definition

Our analysis focused on estimating health care demand conditional on the individual has made the decision to seek care in the existence of the dual practice. The limitation of data makes dual practice identification not appeared directly from an individual perspective but more from provider's side. Data in this analysis combines individual data and health facility data (public community health centre and private practice).

The sample selection process is described in Figure 3A.1 of Appendix 3A. For each step we also report the descriptive statistics for variables included in Table 3A.1A of Appendix 3A. The descriptive statistics shows that our selected sample show consistency with the original sample of IFLS data. The first step of sample selecting process is identifying individuals based on the age as we will exclude children or population within age 14 years old or bellow. The health care decision is made by the adult age 15 years old or above. The total individuals being interviewed in the IFLS sample is 50,148. We take 31,421 individuals age 15 years old or above. Out of 31,421 individuals' age 15 years old or more being interviewed, around 18% or 5,695 individuals visited health care facilities in 4 weeks duration prior survey. We limit the study only for individuals whom visit health care facility for outpatient care. The facilities are public facility such as public hospital and public community health centre. The private facilities are private hospital, private clinics, and private physician practice. There are also facilities which are not attended by physician such as midwifes practice, nurse practice and traditional healer. Physician usually provides services in formal treatment, in public or private health care facility. It should be noted that although we include the public hospital and private hospital, both also still refer to outpatient care. The next selection characteristic is whether the visit is categorized as the first visit. The selection on the first visit only is isolating the decision of visiting health care facility made by the patient from the physician involvement. The criteria cut the sample into 2,686 individuals.

In the next step there are two different matching processes taken to get a sample for the regression processes. The first sample will be matched with the dual practice identification. The information of dual practice activity comes from the community health centre in the area. The questionnaire lists the physician activity outside the public community health centre that can be used to identify a dual practice physician. We use three different administration areas to identify the percentage of dual practice physician: sub district, region, and province. Ideally the percentage represents the sub-district level because public community health centre is available in the sub-district level, but some cases shows that not all individuals in the survey reside in the same sub-district as the community health centre being interviewed. In that case, we use the upper level which is the region level, and in the rare case the province level. Other obstacle appears in the information completeness of health care facilities particularly on the price information. The interview process asked the treatment price based on the basic treatment and diagnose. We also use patient's information on treatment cost to approximate the price for each treatment in each facility. The data available could only identify the price information in which individual actually visits to get the treatment. The price information of two alternatives health care facilities are gathered using information from different individuals who use the two alternative facilities but reside at the same area. The problem appears if there is no information of two facility prices in the same area with the individual. The unmatched cases will reduce the number of observations. The sample matched with dual practice identification is reduced into 1,326 individuals.

A different matching process is taken to get sample for the regression on quality. We identified the sample matched with provider's data. In the regression to analyze the quality effect on individual choice, we only use individual data who visit public and private facility. The detailed questionnaire on quality is only available for the public community health, private clinics and private physician practice. This research addresses the physician quality explicitly as one of the quality component while the traditional healer, midwife practice and nurse practice are not facilities that affiliated with physician practice. We use the two sources to approximate the quality in the public and private facility. The health care facility is not necessarily the one which is visited by the individual but we use the area identification using the sub district as the smallest identification area. The difficulty appears from the low respond rate of private health care facility. While the respond rate of public community health centre is almost 100 percent the respond rate of private facility is quite low, only around 40 percent of the private facility which completely filled the questionnaire mainly on the quality sections. The other consideration is related with the price information. In our previous regression model, we use the individual information on treatment cost to approach the price information of health care facility. By excluding the traditional healer, midwife practice, and nurse practice we can collect information on treatment fee from the special treatment price in the public and private facility. We take the price of treating wounds from both facilities to approximate the price for the public facility and private facility. The selection consideration of this particular treatment is more due to the data completeness reason as the treatment has the highest percentage of completeness rate compare to other price information. After clearing out the missing values commonly from the facility information, the final sample for the dual practice purpose in sub Chapter 3.6.1 are 1,116 individuals and 998 individuals for quality purpose in sub Chapter 3.6.2.

The final sample each process represents all the provinces included in the IFLS main sample but for some provinces, the number of individuals is too small. The sample description is available in the Appendix. Our selected sample consists of individuals from 15 provinces out 23 provinces in the original IFLS sample. The selection criteria notably because we only include individuals which visit health care facility contributes large portion of sample decreasing in this research.

3.5.2 Individual characteristics

To provide a deep understanding of individual characteristics, we explain the descriptive result on the primary sample that will be used in the first model. The administration area identification is simplified between individual reside in Java island and non-Java island. The proportion between individual of Java and Non-Java Island is almost the same with the percentage of Java Island is still higher than non-Java. Most of the individuals in the sample are female, with the 62 percent of female and 38 percent of male. The complete tables can be found in Table 3A.2 to Table 3A.9 Appendix 3A. The proportion between individual visiting public and private facility is almost the same which is around 30 percent, and the last category, the traditional healer, midwife and nurse practice has the highest percentage of around 36 percent.

The average monthly income is 978,777 IDR. The minimum and maximum values of incomes are 20,009 IDR and 14,800,000 IDR. The cross tabulation between monthly income quintile and health care facility chosen by patient shows that the lowest quintile rely on public facility while the highest quintile visit more the private sector. The midwife practice, nurse practice, and traditional healer appear in all level of income quintile, about 30 percent in average. It indicates that people still rely on non-physician facility outside public or private facility. The pattern also appears when we compare the case between rural and urban area utilization. People in rural area still rely much on midwife practice, nurse practice, and traditional healer rather than visit public or private health care facility. Individuals living outside Java Island visit in almost the same proportion between public facility and traditional healer.

In term of transportation cost, the average of transportation cost to the private facility is the highest among others, it is 15,208 IDR while the transportation cost to other facility outside public or private facility has the lowest average, 4,562 IDR. The complete figure appears in the Appendix 3 A Table 3A.9. We also calculate the waiting time to get the treatment, started from registration process in the facility until getting serve by health care personnel. The lowest waiting time is 7 minutes to get treatment in midwife practice, nurse practice and traditional healer. The highest waiting time is to get treatment in public facility, around 30 minutes, while it takes around 25 minutes to get treatment in private facility. The highest price of treatment is in private sector, it is 104,243 IDR while the public and other facility are quite lower than the price in private facility are 44,716 IDR and 30,748 IDR.

3.5.3 Facility characteristics

The facility information comes from 969 public community health centre and 1,597 private health care facilities. The detailed figures are available in Table 3A.11of Appendix 3A. The facility sample represents the public and private facilities available in the same area with the patients. The matching process is using area identification with individual data. The facility quality measured by the facility cleanness shows that most of the facility has high score of the facility quality index. The score indicates the medical instrument completeness, essential medicine completeness, and facility cleanness. We classify the score into two categories: high and low. The private facility has higher average percentage of facility with high score, around 93 percent, while in public is around 78 percent. The health care facility mostly concern on the completeness of the medical instrument, medicine, and cleanness because these three indicators are necessary things that should be available in the facility.

The quality of physician is measured by the percentage of physician in the facility who gets general training. In public health care facility, most of the physician have already involved in additional trainings that support the medical skill after being graduated from medical school. The average percentage of physician with additional training in public facility is 86 percent from total physician in the facility which is much higher compare to the percentage of physician with additional training in the private facility with only 67 percent. The quality physician indicator shows the provider role in providing the additional treatment for their physician. It is a common knowledge that public providers usually give more opportunity for their physicians to get additional treatment as a part of additional benefit of being public physician beside the usual income.

The quality of treatment is described using vignette score that indicates the physician response in managing a particular case. The score shows the completeness of steps in diagnosing patient symptom that should be considered by the physician rather than right or wrong indications in treating the patient. The average total vignette score is 77. When decompose based on public and private facility, the vignette score in public facility has higher average than vignette score in private facility with 85 index unit in public facility compare to 72 index unit in private facility. The score shows the number of physicians' attempt in diagnosing symptoms. Low level of vignette score can be translated that physicians have more ability to diagnose the symptoms.

3.6 Result

3.6.1 Dual Practice and health care access

The estimated result for individual choice of health care facility using multinomial logit regression is reported in Table 3. 5. The corresponding result associated with nested model is presented in Appendix 3B, Table 3B. 3.

Table 3.5 Parameter estimation of individual choice of health care facility before correcting for potential bias

Variables	MNL Coefficient			
	Private VS Public		Traditional healer/nurse/ midwife VS Public	
	Coefficient	Std.Error	Coefficient	Std.Error
(1)	(2)	(3)	(4)	(5)
Dual practice	-3.623**	1.230	-0.508	1.200
Age squared	0.0001*	0.00006	-0.00005	0.00006
Male	0.191	0.153	0.122	0.159
Education				
Primary school	-0.336	0.379	-0.472	0.366
Secondary school	-0.184	0.418	-0.145	0.403
High school	0.267	0.416	-0.303	0.408
Higher education	0.833*	0.450	0.026	0.461
Insurance	-1.325***	0.177	-5.071***	0.719
Ln Income	0.270**	0.098	0.170*	0.102
Severity	0.015	0.012	-0.003	0.013
Urban	0.302*	0.174	-0.310*	0.170
Java	0.237	0.165	-0.088	0.168
Travel cost (private)	0.002540	0.000002	0.018800	0.000002
Travel cost (public)	0.044700	0.000004	0.081100*	0.000004
Travel cost (Traditional healer/nurse/ midwife)	0.016600	0.000001	0.026700	0.000014
Waiting time (private)	0.001	0.002	0.00028	0.001
Waiting time (public)	0.004	0.003	0.001	0.003
Waiting time (Traditional healer/nurse/ midwife)	-0.014*	0.007	-0.003	0.008
Price (private)	-0.022700**	0.000001	0.00396*	0.0000002
Price (public)	0.0035400	0.0000008	-0.0024600	0.0000008
Price (Traditional healer/nurse/ midwife)	-0.0505000	0.0000069	-0.0978000	0.0000074
Const	-0.961	1.684	-0.484	1.744
n	1326			
Log likelihood	-1237.9956			

p<.1; ** p<.05; *** p<.001.
Using multinomial logit model, Visits: 0. Private, 1. Public, 2.Traditional/ midwife/nurse). Base category is public facility.

A likelihood ratio test suggests that the nested multinomial logit model is not better than multinomial logit model as it is usually the case in the previous literature of health care demand model. We also test for the best model among these three regression result and see whether the assumption of independence of irrelevant alternatives is adequate. The complete report of the test is available in the Appendix 3B, Table 3B. 1. For the comparison, another multinomial regression using simplified variables of price, waiting time, and travel cost but with larger sample size is available in Appendix 3B, Table 3B.4. The coefficients have similar signs with the Table 3.5. Our primary focus is the interpretation of dual practice physician and insurance effect, therefore the following discussion is based on the multinomial logit model in Table 3.5.

The coefficient for dual practice variable is statistically significant at 1 percent level in the comparison between choosing private facility or public facility. This implies that the existence of dual practice physician in the facility is importantly affecting the choice of outpatient health care. The dual practice variable gives expected but insignificant effect in the comparison between traditional healer, nurse or midwife facility and public facility. The dual practice physician does not necessarily shifts individuals to change from non-formal facility such as traditional healers, nurse, and midwife to public facility. The percentage of dual practice physician is important in the shifting choice of provider between private and public health care facility. The increasing percentage of dual practice physician in the area associates with the increase of relative log odds of individual visiting public facility compare to visiting private facility. The magnitude of the effect however is small since the relative risk ratio of dual practice is less than one, only 0.027 (Relative risk ratio is presented in Table 3B.2A of Appendix 3B). One percent increase in dual practice percentage can be associated in very small change in number of dual practice physician in the area. Hence people might not realize the difference unless the increasing percentage is quite large number. From the descriptive statistics, it is showed that traditional healer, nurse or midwife still becomes individual first choice to seek health care. The traditional healers, nurse or midwife mostly provide health care treatment from children care, maternity and adult treatment. In order to make an assessment of the impact of dual practice on the choice of provider, the effect of changing the percentage of dual practice ratio is presented in sub Chapter 3.7 together with discussion on the effect of insurance to propose new policy for dual practice regulation in Indonesia.

As expected, the effect of insurance is significance at 1 percent level in the choice of provider. The insurance information is related with whether people use insurance in their last visit health care. This approach is more convincing than using the information whether people is registered in any insurance scheme because people may not using the insurance for several reasons such as visiting facility not affiliated to insurance scheme etc. People with insurance are more likely visiting public health care facility rather than visiting traditional healer, nurse or midwife. The comparison between private and public shows those individuals with insurance are more likely visiting public facility rather than private facility. It should be noted that in general, the treatment in public facility is not free but applied a treatment fee. The magnitude of the effect of insurance to individual choice of healthcare facility is clearly seen in the relative risk value of insurance which is 2.30. For people with insurance relative to people without insurance, the relative risk for visiting private facility relative to public facility would be expected to decrease by a factor of 2.263 given the other variables in the model are held constant. If an individual was having insurance, the relative risk for choose traditional healer, nurse, or midwife relative to choose public facility would be expected to decrease by a factor of 1.023 given the other variables in the model are held constant. The IFLS data shows that around 76 percent of the sample is not having insurance. Among individuals who have insurance, most of them are having public insurance which is insurance for civil servants and subsidized insurance of the poor from the government of Indonesia. These kinds of insurance usually can be applied in public facility. Insurance provides financial protection and directly impacts on public demand health care. In this case, there is an indication of moral hazard as having insurance means greater access to public facility. Providing insurance gives more significant effect to health care demand through access enhancement channel compare to provide more dual practice physician in the system.

Individual characteristics provide evidence that those variables in general are insignificantly affecting the choice of health care provider. The individual characteristics might significantly affect the demand for health care as shown in previous literature but in this research only age is significantly explains the choice of health care between private and public health care facility, while the urban location is significant in the choice between traditional healer and public facility. The significance sign in urban variable implies that individual living in urban area is less likely choose traditional healer over public facility. The result is in line with a previous study in UK (Propper, 2000). The explanation on why many individual characteristics give insignificant sign is that our model directly address the choice of health care while the individual characteristics might provide significant evidence on to visit or not to visit health care facilities.

The coefficient of log income variable is positive and significant at 1 percent level, implying that wealthier individual, the more likely the individual choose private facility over public facility. This result is consistent with the theoretical consideration because higher income group have more financial power to choose between private and public. In this case the public facility is characterized as lower and almost free treatment, but has a longer queue.

Non-treatment cost variables such as travel cost and waiting time are all relevant but in fact provide a small evidence on the factors that involve in individual decision of health care provider. Access to health care facility represented by amount of travel cost to the nearest health care facility shows that the more expensive the costs to public facility, individuals are more likely to choose the traditional healer/nurse/ midwife.

The price of treatment in private facility shows significant coefficient in the decision between private and public facility but not between traditional healer and public facility. Although people are willing to pay for a better treatment in private facility, but the result points out that the increasing price of private treatment will be followed with the decreasing people visit private facility and more people choose the public one. However, the relative risk ratio in Table 3B.2A of Appendix 3B shows that the magnitude is not convincing because the relative risk ratio is close to one.

The result after correction for endogeneity is presented in Table 3.6. We focus on the variables that are our main concern: variable of insurance and dual practice physician. The result of relative risk ratio is available in Table 3B.2B of Appendix 3B.

Table 3. 6. Parameter estimation of individual choice of health care facility after correction for potential bias

Variables	MNL Coefficient (standard error)			
	Private VS Public		Traditional healer/nurse/ midwife VS Public	
	Coefficient	Std.Error	Coefficient	Std.Error
(1)	(2)	(3)	(4)	(5)
Dual practice	-3.869*	1.256	-0.355	1.223
Age squared	0.00006	0.00007	-0.00001	0.00007
Male	0.238	0.160	0.083	0.164
Education				
Primary school	-0.508	0.416	-0.334	0.398
Secondary school	-0.485	0.512	0.098	0.487
High school	-0.077	0.539	-0.020	0.519
Higher education	0.447	0.592	0.329	0.583
Insurance	0.052	1.395	-6.419***	1.573
Ln Income	0.289**	0.101	0.155	0.104
Severity	0.012	0.012	-0.001	0.013
Urban	0.105	0.259	-0.135	0.250
Java	0.241	0.165	-0.096	0.168
Travel cost (private)	0.0000008	0.000002	0.000001	0.000001
Travel cost (public)	0.000005	0.000004	0.000007*	0.000004
Travel cost (Traditional healer/nurse/ midwife)	0.000007	0.00001	0.000002	0.00001
Waiting time (private)	0.001	0.001	0.0002	0.001
Waiting time (public)	0.004	0.003	0.001	0.003
Waiting time (Traditional healer/nurse/ midwife)	-0.014*	0.007	-0.003	0.008
Price (private)	-0.000002**	0.000001	-0.0000003*	0.0000002
Price (public)	0.0000003	0.0000008	-0.0000002	0.0000008
Price (Traditional healer/nurse/ midwife)	-0.000004	0.000007	-0.00001	0.000007
Residual	-1.406	1.415	1.389	1.430
Const	-0.929	1.683	-0.463	1.748
n				1326
Log likelihood				-1235.83

p<.1; ** p<.05; *** p<.001.
Using multinomial logit model, Visits: 0. Private, 1. Public, 2.Traditional/ midwife/nurse).
Base category is public facility.

The coefficient of dual practice physician variable in corrected model has similar negative sign with the non-corrected model in Table 3.5 but has lesser coefficient values. The dual practice is significant in affecting individual choice of health care facility between private and public but insignificant in traditional healer/nurse/midwife and public. People who live in the area with more dual practice physician will be more likely to visit public health facility rather than private facility. The insurance variable in corrected model shows insignificant positive sign for the comparison between private and public, but significant and positive effect on comparison of traditional healer/nurse/midwife and public. The previous result shows that in both comparisons, the coefficient of insurance variable is significant and positive. The coefficient value of insurance in corrected model is smaller than in the non-corrected model. After correcting the endogeneity problem, people with insurance less preferred of visiting traditional healers/nurse/midwife compare to visiting public facility under everything being constant.

The robustness check for both models, before and after the correction bias is available in Table 3A.1A to Table 3A.1F of Appendix 3A. Both models are qualified as good model to represent individual choice of health care facility.

3.6.2 Dual Practice, quality, and the choice between private or public

The estimated results for the quality model are reported in Table 3.7 with the different measurement in price component. The complete result of odds ratio and robustness check of the model is available in Table 3B.6 and Table 3B.7 Appendix 3B. Dual practice variable shows positive and significant coefficient in both models. The increasing percentage of dual practice physician in public facility leads to increasing probability people visit public facility rather than private facility.

Table 3. 7 Parameter estimates of individual choice of health care facility with quality factor

Variable	Model 1		Model 2	
	Coefficient	Std.error	Coefficient	Std.error
(1)	(2)	(3)	(4)	(5)
Dual practice	3.248*	1.1882	3.964**	1.755
Age	-0.0001**	0.00005	-0.0001**	0.00006
Male	-0.100	0.137	-0.144	0.143
Education				
Primary school	0.669*	0.355	0.380	0.372
Secondary school	0.568	0.384	0.195	0.404
High school	0.122	0.378	-0.244	0.399
Higher education	-0.428	0.404	-0.692	0.427
Insurance	1.412***	0.151	1.312***	0.162
lnIncome	-0.339***	0.085	-0.202**	0.090
Severity	-0.013	0.012	-0.009	0.012
Urban	-0.035	0.162	-0.149	0.166
Java	-0.501	0.367	-0.383	0.382
Travel cost (private)	-0.0000007	0.000002	-0.000002	0.0000003
Travel cost (public)	-0.0000001	0.0000005	-0.00000004	0.0000008.5
Waiting time(private)	0.002	0.001	0.0008	0.0008
Waiting time (public)	-0.005**	0.002	-0.000001**	0.002
Price (private)	- 0.0000000002*	0.0000000001	0.000001	0.0000010
Price (public)	-0.0000000001	0.0000000004	-0.0000001	0.0000007
Quality facility (private)	-0.429	0.446	0.275	0.367
Quality facility (public)	0.064	0.263	0.135	0.230
Quality physician (private)	-3.244	2.346	-0.166	1.584
Quality physician (public)	2.210	2.260	-0.790	1.127
Quality treatment (private)	0.048	0.042	-0.003	0.022
Quality treatment (public)	-0.174*	0.091	-0.078*	0.044
Cons	13.843**	4.990	7.705	3.628
n	1116		998	
Log likelihood	- 671.041*		-615.25102	

* p<.1; ** p<.05; *** p<.001
Use logit model, logit model with dependent variable of visiting public or private provider. The reference category is private facility.
The difference between Model 1 and Model 2 is on the price variable approach where Model 1 uses price data taken from a certain treatment fee in the facility. Model 2 uses price variable from patient's expenditure when visiting health care facility.

In this model, we emphasize the role of quality component in patient's decision to visit private or public health care facility. Among the three quality measurement: facility, physician, and treatment, only the quality treatment in public is significant. We use the score of vignette questionnaire for adult treatment to approximate the level of quality treatment in the facility. The significant component gives the expected sign and it can be interpreted that when the quality of treatment in public facility is increasing, people will be more likely to visit to public facility. The negatives sign is due to the use of the vignette score which indicates that the higher vignette score means the physicians are less spontaneous in diagnosing patient to find the best medical solution. This is an approach to quantify quality treatment provided in health care quality in the IFLS 5 questionnaire. The smaller vignette score means that physicians are more thorough full in diagnosing a patient's symptom. From the patient view, this score can be represented the physician-patient interaction during the medical consultation by providing physical check-up or asking prompted questions.

Only quality of treatment in public facility among three quality variables shows the significant and negative sign in both model 1 and model 2. The measurement uses vignette score of how physician in each facility provides treatment. The low score means that physician is spontaneously answering the questions in order to diagnose the symptoms during interview. It describe that physician performance in providing health care treatment is excellent. While the higher score means that physicians need more approach in diagnosing patient's symptoms. The interpretation of the regression in Table 3.7 shows the expected sign that the more physician can perform well in public facility, the more patients will come to public facility. Results on both models show the insignificant coefficient for the rest of quality components which are quality of facility and quality of physician. It confirms the argument that individual or patient is also less informs about quality aspect. In our result, the facility quality is a mixed measurement between facility cleanness, the completeness of instrument, and the stock of medicine in the facility. The insignificant sign might come from the merging of these three indicators into single variable. We have already tried to separate the three indicators of facility quality, for example we include only the facility cleanness score into the regression as this indicator might be the easiest indicator to observe by patients compare to the completeness of instrument and medicine in the facility. The result again provides the insignificant sign. The reasonable explanation is that most facility has already met the minimum standard of cleanness, instrument, and medicine completeness. From the patient's perspective, the patient might assume that the quality of facility between public and private is similar so that the choice is not based on the facility quality but from other different aspects. The closer look into descriptive of statistic shows that only a few facility that has low score while most of facility has average score or higher. We should mention that our study is limited for outpatient care only that mostly provide primary care hence most of the instrument and medicine can be well provided in both facilities.

The physician quality is indicated by the ratio of physician who receive or attend additional training after finishing medical school shows consistent sign although still insignificant. Among several trainings provided in the questionnaire, we use the particular training for adult treatment. The additional training seems to be a necessary as most physicians have it, but patients do not observe this information. Physician's training together with physician's original university might be necessary for the facility reputation, but in our result, the patient cannot identify the physician quality directly. The insignificant sign can be also interpreted as the information gap between patient and physician during the medical treatment. The patients might have not enough information on the expected treatment based on their treatments.

The quality of facility and quality of physician are two quality aspects that insignificant on the patient's decision to visit public or private facility. Both quality aspects have the expected signs although not significant but the result might support our claim that the higher quality level in public facility and public physician, patients will be more likely to visit public facility. While the higher level of private facility and private physicians lead to the decreasing odds for patient to go to public facility. There is a difference between quality treatment in public and private, the mean difference test shows significant difference between the two score means of quality treatment in public and private facility. The result of the quality aspects in affecting health care facility choice shows that people might experience difficulties to observe the quality and to quantify the expected quality of treatment. But on the other side, people still value the quality interaction between physician and patient during the process. Hence the quality treatment is one of the concern for individual in seeking care.

The price variable indicates that individual is less sensitive to it. Both approach in price measurements shows only one variable price is significant in the model, the price in private facility, but gives the unexpected sign. The increase price of private treatment leads to the less likely people chooses public facility. The price of public treatment gives the expected sign but insignificant and so do the other prices using out of pocket payment approach.

3.7 Policy implication

We will bring the result into policy discussion mainly related with dual practice and insurance provision. As a reference, we collect information of insurance premium from Social Security Administrator for Health (BPJS, a government agency that provides health insurance in Indonesia), Table 3.8.

Table 3. 8 Insurance schemes from Social Security Administrator for Health (BPJS)

Class	Premium/month (IDR)	Outpatient benefits	Inpatient benefit
(1)	(2)	(3)	(4)
First	80,000	There are no differences between classes in outpatient treatment. The difference between classes is different claim tariff from hospital to BPJS based on disease's grouped (INA-CBGs).	Get facility in first class bed in hospital, around 2-4 beds per room. Able to upgrade to VIP class by paying the room price differently.
Second	51,000		Get facility in second class bed in hospital, 3-5 beds per room. Able to upgrade to higher class by paying the room price different.
Third	30,000		Get facility in third class bed in hospital, 4-6 beds per room. Unable to upgrade to higher class based on owned request.
PBI (aid recipient)	23,000 (paid by government)		Get facility in third class bed in hospital, 4-6 beds per room. Unable to upgrade to higher class based on owned request.

To approach the information of providing dual practice in the system, we use the information on salary of physician with temporary employee status (Table 3.9). This is a particular program from government of Indonesia to increase the physician post in remote areas. Physician will work in public facility, usually fresh graduate physician, with temporary contract for one to three years contract based on replacement area category.

Table 3. 9 Salary and incentives for public physician under temporary contract

Placement area	Salary*	Incentive*	Total (salary+incentive)*	Contract
(1)	(2)	(3)	(4)	(5)
Normal area	2,800,000	None	2,800,000	3 years
Remote area	2,800,000	10,300,000	13,100,000	2 years
Very remote area	2,800,000	13,000,000	15,800,000	1 years

*Currency in Indonesian Rupiah (IDR)

We will use the case of aid recipient premium (23,000 IDR) and total salary plus incentive for physician in normal area (2,800,000 IDR) for the policy simulation as the insurance premium is paid by the government and we take the lowest possible salary for physician. The choice enables us to provide easy interpretation for the policy implementation.

SCENARIO 1

We will use the health insurance scheme for aid recipient (PBI) to describe policy scenario. Suppose health authority has 100 Million IDR additional budget per a year. The health authority decides to finance health insurance for PBI. This is a specific health insurance scheme for the poor. We simulate the poor group using the lowest quintile of individual monthly income. The health insurance for PBI a year costs 12 x 23,000 IDR = 276,000 IDR. The yearly budget can provide additional 100,000,000 IDR: 276,000 IDR = 362 insurance packages per year.

The policy implication uses the estimation of the multinomial logit before correcting endogeneity (Table 3.5). However we concern the endogeneity problem in our model as appears previously in Sub Chapter 3.6.1 Table 3.6. We categorize individuals based on income quintile and insurance status as appears in Table 3. 10. We use this table to randomize the change of given insurance in the simulation process. In the simulation process, we will change 363 individuals with no insurance in the lowest quintile to have insurance. We calculate the average predicted probability for all outcomes (private, public, and traditional healer, midwife or nurse).

Table 3. 10 Number of observations based on income quintile and insurance status

Quintile	Having insurance?		After simulation, Having insurance?	
	No	Yes	No	Yes
(1)	(2)	(3)	(4)	(5)
1st quintile (the lowest)	363	103	1	465
2nd quintile	387	106	387	106
3rd quintile	427	96	427	96
4th quintile	442	103	442	103
5th quintile (the highest)	459	143	459	143
TOTAL	2,078	551	1,716	913

The result in Table 3. 11 shows the predicted probability after the simulation in additional health insurance beneficiaries, the average predicted probability of choosing public facility is increasing, while the average predicted probability choosing private facility only slightly increasing. The large difference occurs in the average predicted probability of choosing traditional healer, midwife or nurse, which is smaller after the simulation. The closer looks into the particular income quintile which receives treatment in health insurance shows large gaps, with increasing figure is more than double in the average predicted probability of choosing public facility, and huge decreasing in the average predicted probability of traditional healer, midwife or nurse.

Table 3. 11 Mean predicted probability outcomes

Outcomes	Obs	Mean Predicted probability	Mean Predicted probability (simulation)	Obs (The lowest quintile income group only)	Mean Predicted probability	Mean Predicted probability (simulation)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Private	1613	0.37	0.38	293	0.31	0.37
Public	1613	0.22	0.29	293	0.23	0.58
Traditional healer/midwife/nurse	1613	0.41	0.33	293	0.46	0.05

*Based on the result in Table 3.5

Table 3.12 provides comparison between outcomes and correctly predicted outcomes using multinomial logit model. In general, model can modestly predict the outcomes, about 60 percent. The rule of thumb usually sets the percentage of 50 percent as the lowest percentage of sufficient correctly predicted outcomes. The model can predict most correctly especially in the private and traditional healer, midwife or nurse outcomes. The correct prediction percentages for both outcomes are 64 percent and 81 percent. The model is less powerful predicts the public outcome, as the percentage of correct prediction is 16 percent.

Table 3. 12 The outcomes and correctly predicted outcomes

Outcomes	Correctly predicted outcomes (based on the highest prob)			
	Private	Public	Traditional healer/midwife/nurse	Total
(1)	(2)	(3)	(4)	(5)
Private	380	31	182	593
public	118	57	185	360
Traditional healer/midwife/nurse	115	8	537	660
Total	613	96	904	1,613

*Based on the result in Table 3.5

Table 3. 13 shows the highest predicted probability between three outcomes (private, public, and traditional healer, midwife or nurse) for all observations in the first visit sample. It shows the highest percentage is the traditional healer, midwife or nurse outcome, about 56 percent and the lowest percentage is the public outcome, only 6 percent. The simulation of additional health insurance beneficiaries changes the composition percentage of predicted probability. After the simulation, about 19 percent of observation in traditional healer, midwife or nurse changes to public.

Table 3. 13 Highest predicted probability outcomes before and after health insurance simulation

Highest predicted probability outcomes	Highest predicted probability outcomes after simulation			
	Private	Public	Traditional healer/midwife/nurse	Total
(1)	(2)	(3)	(4)	(5)
Private	578	35	0	613
public	0	96	0	96
Traditional healer/midwife/nurse	21	170	713	904
Total	599	301	713	1,613

*Based on the result in Table 3.5

Table 3. 14 Highest predicted probability outcomes before and after health insurance simulation in the lowest income quintile

Highest predicted probability Outcomes	Highest predicted probability outcomes after simulation only in the first income quintile			
	Private	Public	Traditional healer/midwife/nurse	Total
(1)	(2)	(3)	(4)	(5)
Private	41	35	-	76
public	0	26	-	26
Traditional healer/midwife/nurse	21	170	-	191
Total	62	231	-	293

*Based on the result in Table 3.5

The partial looks into the composition of predicted probability in the lowest income quintile is in Table 3. 14. Before the simulation, the highest percentage predicted probability is traditional healer, about 65 percent but after the simulation the highest percentage predicted probability is public, about 79 percent. After the simulation, there is 89 percent of observation who change from traditional healer, midwife or nurse to public, and 11 percent observations change to private. There is no observations stay in traditional healer, midwife or nurse after the simulation. Compare to the complete sample for the data distribution of each income quintile to health care facility in Table 3.15, we can conclude that visit to traditional healer, midwife, or nurse seems to have bigger impact from the insurance coverage policy.

Table 3. 15 The visit to health facility based on income quintile

Quintile	Visit to health facility			Total
	private	public	traditional healer/midwife/nurse	
(1)	(2)	(3)	(4)	(5)
1st quintile (the lowest)	200	380	378	958
2nd quintile	254	370	443	1067
3rd quintile	304	328	495	1127
4th quintile	327	347	492	1166
5th quintile (the highest)	503	277	475	1255
Total	1588	1702	2283	5573

SCENARIO 2

The second scenario works using the similar process, but in this case, we simulate the ratio of dual practice physician in a public facility. Using the same amount of budget, 100 Million IDR per a year, the government can add about three physicians in a standard category replacement area. The choice of using the criteria is considering the minimum level of physician salary that will make the interpretation easier for the policy implication. In the simulation we add these three physicians in one of the province outside Java Island. The result of predicted probability as follows:

The result in Table 3.16 shows that in general the mean predicted probability after simulation is unchanged. Putting more dual practice physician in the system has insignificant change on the mean predicted probability. The detailed look on province level data shows that the mean predicted probability of visiting private facility is decreasing while the mean predicted probability of visiting public is increasing, and the mean predicted probability visiting traditional healer, nurse or midwife is constant. The change in mean predicted probability between public and private health care facility shows that patients more convenience to come to public facility after additional numbers of dual practice physician in the area.

Table 3. 16 Mean predicted probability outcomes

Outcomes	Mean Predicted probability	Mean Predicted probability (simulation)	Obs (in particular province)	Mean Predicted probability	Mean Predicted probability (simulation)
(1)	(2)	(3)	(4)	(5)	(6)
Private	0.37	0.37	150	0.38	0.36
Public	0.22	0.22	150	0.16	0.18
Traditional healer/midwife/ nurse	0.41	0.41	150	0.46	0.46

Note: Number of observations is 1613.
Based on the result in Table 3.5

The change in predicted probability after the simulation in particular province outside Java Island shows the slightly increasing in the average predicted probability of public outcome comes from the change in private outcome, while the average of traditional healer, midwife or nurse remain unchanged. The highest predicted probability outcomes in table 3.17 and table 3.18 support the conclusion that the change mainly comes from private outcome to public, while the traditional outcome is constant.

Table 3. 17 Highest predicted probability outcomes before and after simulation (all sample)

Highest predicted probability Outcomes	Highest predicted probability outcomes after simulation			
	Private	Public	Traditional healer/midwife/nurse	Total
(1)	(2)	(3)	(4)	(5)
Private	610	3	0	613
public	0	96	0	96
Traditional healer/midwife/nurse	0	0	904	904
Total	610	99	904	1,613

Table 3. 18 Highest predicted probability outcomes before and after simulation (particular sample)

Highest predicted probability outcomes	Highest predicted probability outcomes after simulation			
	Private	Public	Traditional healer/midwife/nurse	Total
(1)	(2)	(3)	(4)	(5)
Private	50	3	0	53
public	-	-	-	-
Traditional healer/midwife/nurse	0		97	97
Total	50	3	97	150

The first scenario with insurance coverage, it shows that the policy might affect only for those individuals who receive the extra insurance. While dual practice policy potentially reaches much larger population. In both policy scenarios using annual budget of 100 Million IDR, government can add around 365 insurance packages per year. It means that there are 365 individuals that directly affected with the insurance policy. The same budget can provide three more dual practice physicians. We place these physicians into a certain province so the percentage of dual practice physician in public community health center will change from 0.68 to 0.71. Based on the number of population in the province, each public community health center serves around 23,733 people. Before the policy scenario, about 16,138 people were served by dual practice physician. After policy implementation, there are 16,850 people are served by dual practice physicians. The difference between 16,138 and 16,850 is 712 people. So we can say that the dual practice policy in our example affect to 712 people, almost double the size of people affected with insurance policy. Having more people served by dual practice physician means that the chance for people getting treatment from physician is increasing because the dual practice physician will provide extra services at his private practice. So people who cannot get treatment in public (because of opening hours or distance) they can visit his private facility. Thus the policy effect might be small at the individual level but might be larger at the community level.

3.8 Discussion

Drawing from the experience of Indonesia, this article contributes to the literature on dual practice physician and health care demand in the following ways. First, the use of dual practice physician ratio in the public facility to measure the role of dual practice physician in the health care system directly was not found in the previous literature before especially in the developing country setting. The monitoring of dual practice physician usually is not done regularly; hence the usual source of dual practice physician data comes from particular survey. Second, this research provides policy implication regarding the rules of dual practice regulation and health care insurance scheme in providing access to health care particularly the use of formal health care provided by physicians. We analyse what policy gives better outcome in term of health care access to formal health care facility. The formal care sector refers to health care facility attended by physician and it is owned by government or managed by private company, for the outpatient care in Indonesia refers to public community health centre and private clinics. The non-physician practice is a facility attended by health care personnel other than physician such as nurse or midwife, in this research we include the traditional healer into the same category as non-physician practice. Finally, we use data from IFLS wave 5 which allows us to identify treatment and non-treatment cost variables such as travel cost and waiting time. The expected treatment cost for unchosen alternative in the choice set for an individual was imputed by taking into account the provider type and geographical location to address individual heterogeneity of the expected price of care faced by an individual. We provides alternative model to address the recent method of health care demand analysis using nested multinomial logit regression. This method allows us to model health care demand as steps of decisions made by patients. Our focus of study is precisely on analysing the role of dual practice and we argue that there are different aspects between providers in the study. We complete the discussion that is supported by statistical test to determine proper method. We decide to use the multinomial logit as it provides more natural interpretation needed for our cases.

Our study also considers the endogeneity issue in the model related with insurance ownership to individual choice of health care facility. After correcting the model for this potential bias, the result confirms the dual practice and insurance effect to individual choice of health care. The magnitude of related variables is lower than the non-corrected model, but it provides significant and similar sign. Dual practice physician in the area is important influencing factor to choose between private and public facility. The insurance ownership has meaningful effect in individual choice between traditional healer/nurse/midwife and public facility.

The dual practice physician existence is statistically significant in determining individual choice of health care provider between private and public but not between non-physicians facility to public or private facility. The significant sign in dual practice variable confirms the fact that the available supply of health care services indirectly influences individual's decision on health care choice. The increasing percentage of dual practice physician is associated with more private practice available in the system but the result shows that the increasing percentage of dual practice physician affect individual to visit public facility rather than private facility. The result might come from the fact that there are many public facilities that were not attended by physician, so the increasing of dual practice physician also means that public facilities are attended by physician or have more physicians than before. The physician capacity in public is more recognizable by patients rather than additional private practice offered in the system. The insignificant coefficient of dual practice in the decision between non-physician facility and public facility can be explained from the mixed effect of several facilities in the category of non-physician facility. In this category we have traditional healer, nurse practice, and midwife practice. Based on our data description on health care utilization, people still rely on nurse practice and midwife practice. Public facility in this case is public community health centre, is dominated by nurses and midwives as the main health care personnel. The number of physician in each public community health centre is limited, usually one physician per facility for the minimum requirement but in some cases the facilities have no physician. So people could come to public community health centre but still received treatment from nurse or midwife. People could also come to nurse practice or midwife practice because these facilities offers flexible opening hours and cheaper treatment fees compare to private physician practice. Hence the increasing percentage of dual practice physician provides insignificant effect of the individual decision on health care facility.

On the other hand, the insurance coverage has significant impact on the individual choice of health care providers. The insurance beneficiaries will be more likely to use formal health care rather than traditional healer, nurse practice, midwife practice. Between private facility and public facility, individual insurance scheme will choose public facility. The financial barrier has more substantial effect rather than supply barrier although only price of treatment in private facility is significant affecting the individual choice. From the non-monetary factors only the travel cost to public facility significantly affects the individual health seeking behaviour between public and traditional healer. This information actually supports the claim that dual practice availability might reduce the travel distance and makes travel cost lower. Other rationale behind why insurance gives more impact on the health seeking behaviour might be on the emergency level that enforces individual to seek care. The measurement of severity illness uses number of days with health problem. Around 33 percent of the sample has zero days, and around 68 percent of the sample has 3 or less days with health problem. When people are not disturbed enough with the illness they will choose the nearest or most accessible facility to get treatment. From the descriptive result, the travel cost and waiting time of traditional healer are the lowest compare to others choices. The closer look into the data on health insurance shows that almost 40 percent of insurance holders are covered under health insurance program from government which can be applied mostly in public health care facility and not for the non-physician practice. Hence the provided insurance that can only use in the public or private facility will drive individuals to visit private or public facility rather than traditional healer. The data support the argument that health care insurance can enhance the health care access. Moreover, individuals consider about the price when they want to visit health care facility and this is supported by the result that the price in private facility significantly affects health seeking behaviour. The descriptive statistics shows that the highest price on treatment is in private facility, while the lowest is for traditional healer.

The significant result of price variable confirms the reasons why many people still rely on non-formal treatment. The price of treatment is one of the obstacles for individuals accessing health care services primarily when accessing private facility. The average price of treatment in private facility is the highest among the other two facilities. The negative sign shows less attractiveness of private facility when the price of treatment is getting higher. Related with the dual practice policy, the public physicians provide more services in private facility, hence more services available for individuals but at the same time, individuals still struggle to afford the services in private facility. Furthermore, non-physicians facility still becomes the main option when it comes to health care facility decision.

Travel cost variable represents one of non-monetary factors that also relates with patient's decision on visiting health care facility. The result shows that the cost to go to the healthcare facility is importantly affecting the decision making process. The higher travel cost to a public health facility, the more likely individual chooses an alternative treatment other than the public one. Individual generally will choose the lowest travel cost in order to minimize total cost of seeking care. In Indonesia health care provision system, the public community health centre usually available in every district. But there are still many people who have difficulties in visiting public community health centre because of far distance, bad road conditions, or lack of public transportation system. Those will make cost to get to the facility become expensive. People might prefer to get treatment from health care facilities nearby such as nurse practice, midwife practice or traditional healer rather than rely on public providers. The government of Indonesia has applied the "Bidan

Desa" program in the past. This is a particular program that places midwife in the remote village to work in public community health sub centre and she can open private practice. It is a public community health centre in village level that attended by midwife or nurse only. The government implements the program in the expectation of providing alternative options for the people who live far away from the public community health centre. This also explains on the popularity of the nurse practice and midwife practice among people. Another non–monetary variable is the waiting time that measures how long patients have to wait from to get treatment, from the registration process until they meet the physician. The result on waiting time variable shows that individuals do not concern much on how long they have to queue in the facility to get treatment. It seems that people's priority is to get treatment so as long as they get health services needed; there is no issue on waiting time. The general characteristic of public sector has the longest waiting time among three categories, while the shortest waiting time is on the category of non-physicians facility. Like any other non-formal facility, the traditional healer might has more flexible opening hours hence individuals could quickly come and get treatment.

The finding in individual characteristics provides mix results in comparison with the previous studies. Age is important variable in the demand of health care, the result is consistent with Sarma (2009). The older people are less likely to demand formal care from private health care. The education is not mattered is consistent with Gertler and Van der Gaag (1990). There is no evidence that we can differentiate health care demand based on choice of provider according to individual's education level. The location identification involves whether individual lives in rural-urban areas and Java Island-outside Java Island. The result shows that rural and Non-java Island individual relies more on the public facility in seeking care. Indonesia like other developing countries faces development discrepancy that marked by concentration population in the specific area. In this case, Java Island is inhabited by almost 60% of the population in Indonesia. In contrast with population pattern in 1980 where around 78% population lives in rural area, nowadays half of population lives in the urban area. The health care personnel distribution still becomes the main issue. The average number of physician per public community health centre is increasing since 1996, but more public facility lack of physician especially in rural area. The physician ratio is 18 physicians per 100,000 in 2006, while it is only 15 physicians per 100,000 populations in 1996. Based on health statistics data by Ministry of Health in 2015, on average 26% from total public community health centre is categorized as deficient in term of physician sufficiency ratio which means there are 26% public facility is still lack of physician. The average has large different with minimum percentage is 0.83% and the maximum percentage is 65.74%. Based on 2012 facility survey, there is still 4.2% community health centre without general physician and 16 percent among of them is located in eastern provinces of Indonesia. The physician ratio in the urban area is 36 physicians per 100,000 populations while it is only six physicians per 100,000 populations in rural areas.

We compare the analysis of proposed policy through the insurance channel and dual practice channel. The interpretation from the regression coefficient shows that the effect of insurance has almost ten times larger than the effect of increasing the dual practice physician. Providing one insurance pack (using the subsidized insurance scheme) only costs around one tenth of providing one more dual practice physician in the system (using the public salary for the contract physician in normal area). The results indicate that two policies, dual practice physician and insurance coverage affect the demand of health care in different ways. The direct comparison between two policies in general shows that the insurance gives higher impact on the health care demand compare to increasing the number of dual practitioner. This result should be carefully translated that both policies have different objectives in realizing health care enhancement in Indonesia. The increasing number of health care insurance beneficiaries can shift people from visiting traditional healer into formal practice, public health care facilities. The increasing number of dual physician practitioner seems only affecting to shift individual between private to public facility. As we have already seen in the data description that many people still rely on non-formal facility, hence to increase the access to formal facility, the policy should give more attention by providing more insurance particularly for indigent people.

Further question that might appear regarding dual practice physician is related with the increasing demand of health care. Our results show that dual practice physician responsible for the extension demand of health care rather than the increasing demand of health care particularly formal treatment that attended by physicians in public or private facility. We investigate the relationship of dual practice physician with the increasing demand by analysing the decision whether patients decide to seek care or not. The analysis can be described as individual decision in the first part of Figure 3.6. The complete result is available in Table 3B. 8 of Appendix 3B. The analysis uses a sample size of 13,885 individuals age 15 years or above. The dependent variable is binary variable of 1 indicates individual decide to seek care and 0 if individual is not seeking care during four weeks prior the survey. The dual practice physician shows insignificant coefficient to individual decision to seek care. This indicates that demand of health care seems insensitive with dual practice physician situation. The result emphasizes the fact that dual practice role in health care demand is on the demand health care extension not in the increasing of health care demand. Hence we concentrate on individual choice of health care facility after they decide to seek care as appears in the bottom part of Figure 3.6.

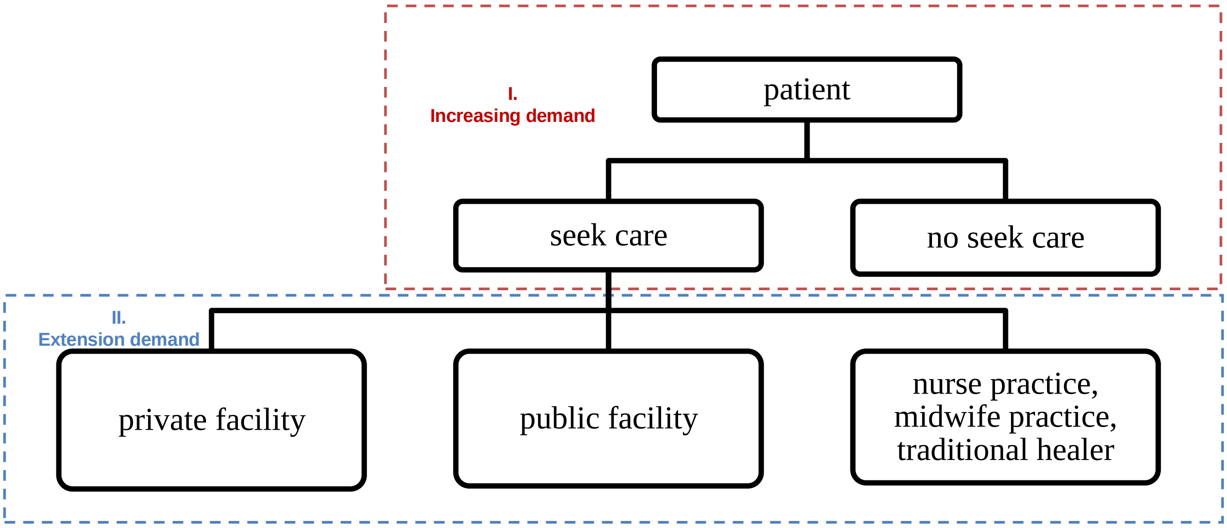

Figure 3. 6 Decision steps that represent increasing demand and extension demand of health care

3.9 Conclusion

The initial purpose of allowing dual practice for physicians is to increase health care access coverage as a government effort in ensuring health care services for all citizens. Indonesia health care utilization is still characterized with the use on non-physician practice (nurse, midwife and traditional healer). The physician deployment is constrained by geographic barriers that make some areas have sufficient access on health care while others might have poor condition on accessing health care services. The dual practice physician availability in the system is not directly affecting individuals to use more formal care compare to non-physician facility. The dual practice enables services more available in the area but at the same time the individuals have hardship in term of financial access. Therefore dual practice is not directly changing individual health seeking behaviour from non-formal to formal treatment.

Insurance ownership is proven to have significant effect on switching individual's choice from non-physicians facility to formal care in private or public health care facility. The geographic difference contributes on the difference pattern of health seeking behaviour. The urban area in Java Island is preferred utilizing more on private facility rather than utilizing non-formal care. The individuals living in rural area still relies more on non-physicians treatment facility and it confirms the fact that private sector is well developed in urban and Java Island category rather than in rural and non-java category.

This research emphasizes two policy instruments to analyse health care access in Indonesia by simulating additional dual practice physician in the area and insurance ownership in the population. The first is regarding dual practice physician that makes health care services more accessible. The second is insurance ownership that lifted financial barriers for population. Providing insurance has direct impact into switching individuals from non-physician health care facility to more formal care provided in public or private facility. While adding dual practice physician is not directly change the individual pattern of seeking health care from non-physician facility to public facility but more to the community level effect. The area in aggregate will be affected when more dual practice physician available in the system. Providing insurance will have effect particularly for those individuals who receive the benefits. While the dual practice policy might potentially affect larger size of population as many more people have opportunity to get treatment from dual practice physician.

Our research has managed to identify dual practice physician indicator based on IFLS survey. We calculate the percentage of dual practice physician from public health community centre questionnaire and get the average ratio in the particular area. The more adequate information on dual practice physician should regularly be collected in order to get clearer picture on how dual practice affected health care demand. The regular data also provides monitoring function that will be useful to organize the dual practice activities. Our study only analyse the dual practice activity among physician while dual practice activity is also common in Indonesia for other medical personnel such as midwife and nurse. We limit our study of health care demand on the patient care, while it is also essential to have depth understanding on dual practice and insurance in different level of care such as inpatient care because it is usually characterized with more expensive treatment and severe illness.

Appendix 3A. Sample process and dual practice identification

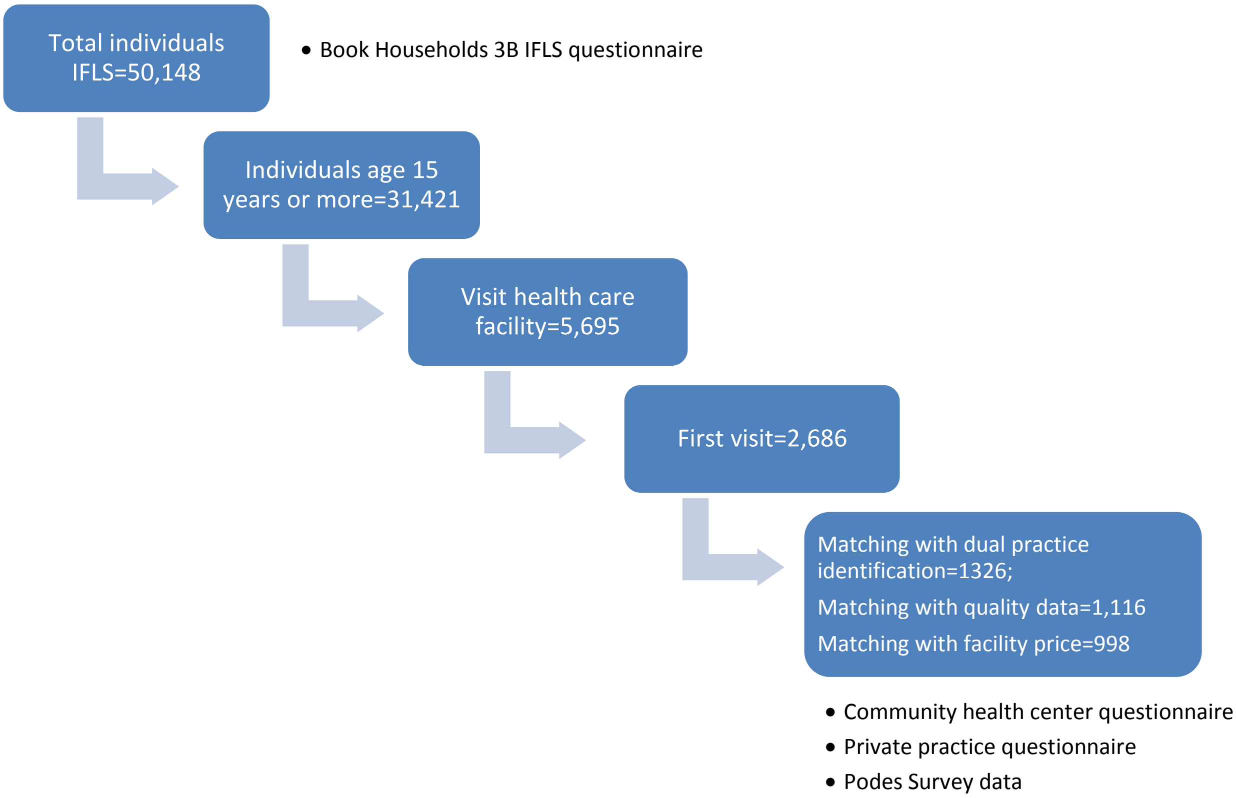

Figure 3A.1 Sample selection process

Table 3A.1A Descriptive statistics for each step of sample selection

Variables		N=31,421	N=5,695	N=2,686	Selected sample (N=1,326)
(1)		(2)	(3)	(4)	(5)
DP percentage	Mean	0.75	0.75	0.75	0.76
	Std. Dev	0.06	0.06	0.07	0.08
	Min	0.50	0.50	0.50	0.65
	Max	0.95	0.95	0.93	0.93
Age	Mean	37.3	39.7	38.6	39.8
	Std. Dev	14.9	15.3	15.0	15.7
	Min	14	15	15	15
	Max	101	94	90	90
Gender	Male	14,689 (53.2%)	3,750 (34.1%)	1,010 (37.60%)	510 (61.54%)
	Female	16,726 (46.8%)	1,945 (65.9%)	1,676 (62.40%)	816 (38.46%)
Education	Not having school	1,293 (4.12%)	253 (4.62%)	111 (4.13%)	65 (4.90%)
	Primary school	9,283 (29.55%)	1,754 (30.80%)	804 (29.93%)	451 (34.01%)
	Secondary school	6,112 (19.45%)	1,053 (18.49%)	503 (18.73%)	268 (20.21%)
	High school	10,383 (33.05%)	1,768 (31.04%)	844 (31.42%)	390 (29.41%)
	Higher education	4,348 (13.84%)	857 (15.05%)	424 (15.79%)	152 (11.46%)
Having insurance	Yes	15,426 (49.09%)	3,130 (54.96%)	1,421 (52.90%)	700 *(52.79%)
	No	15,995 (50.91%)	2,565 (45.04%)	1,265 (47.10%)	626 (47.21%)
Income Mean (Std.Dev)		1,154,302 (4,076,360)	1,333,057 (8,864,029)	1,212,862 (1,660,980)	978,777 (1,097,321)
Severity Mean (Std.Dev)		2.1 (4.5)	4.2 (6.5)	3.9 (5.8)	4.0 (6.0)
Urban	Urban	18,543 (59.01%)	3,432 (60.26%)	1,593 (59.31%)	751 (56.64%)
	Rural	12,878	2,263	1,093	575

Variables		N=31,421	N=5,695	N=2,686	Selected sample (N=1,326)
(1)		(2)	(3)	(4)	(5)
		(40.99%)	(39.74%)	(40.69%)	(43.36%)
Java	Java	17,120 (54.49%)	3,290 (57.55%)	1,505 (56.03%)	770 (58.07%)
	Non-Java	14,301 (45.51%)	2,405 (42.23%)	1,181 (43.97%)	556 (41.93%)
Travel cost Mean (Std.Dev)	0	21,574(104,108)	18,999 (95,779)	17,634 (74,249)	15,208 (64,848)
	1	10,652(62,583)	13,069 (88,810)	14,154 (104,843)	11,298 (53,206)
	2	6,574 (22,224)	6,455 (22,538)	5,918 (19,264)	4,562 (6,131)
Waiting time Mean (Std.Dev)	0	29.6 (83.5)	27.5 (77.7)	27.2 (73.1)	24.9 (55.1)
	1	30.5 (44.00)	31.8 (44.9)	30.2 (44.2)	30.4 (45.4)
	2	7.4(12.9)	7.5 (13.2)	7.2(12.8)	6.9 (10.7)
Price Mean (Std.Dev)	0	108,781 (245,371)	109,107 (274,195)	104,755 (261,792)	104,243 (298,173)
	1	51,937 (113,696)	51,015 (130,245)	54,118 (145,208)	44,716 (99,114)
	2	46,191 (505,854)	41,015 (359,127)	35,667 (35,784)	30,748 (11,312)

*) Our previous sample was using insurance as "do you using insurance when visiting health care facility in a month prior to survey?" This questions only appears when people visit health care facility, while having insurance/not having insurance question appears for all individual in the survey (15 years or above)

	N=5,695		N=2,686		Selected sample (N=1,326)	
Using Insurance (1)	Frequency (2)	Percent (3)	Frequency (4)	Percent (5)	Frequency (6)	Percent (7)
Yes	1,322	23.21	563	20.96	256	19.31
No	4,373	76.79	2,123	70.04	1,070	80.69
Total	5,695	100.00	2,686	100.00	1,326	100.00

Table 3A. 2 Number of individuals in the selected sample based on province

Province (1)	Freq. (2)	Percent (3)	Cum. (4)
Sumatra Utara	96	7.24	7.24
Sumatra Barat	48	3.62	10.86
Sumatra Selatan	60	4.52	15.38
Lampung	35	2.64	18.02
Bangka Belitung	2	0.15	18.17
DKI Jakarta	68	5.13	23.30
Jawa Barat	201	15.16	38.46
Jawa Tengah	191	14.40	52.87
DI Yogyakarta	112	8.45	61.31
Jawa Timur	152	11.46	72.78
Banten	46	3.47	76.24
Nusa Tenggara Timur	117	8.82	85.07
Nusa Tenggara Barat	149	11.24	96.30
Kalimantan Selatan	21	1.58	97.89
Sulawesi Selatan	28	2.11	100.00
Total	1,326	100.00	

Table 3A. 3 Number of individuals in the selected sample based based on Sex

Sex (1)	Frequency (2)	Percent (3)	Cumulative (4)
Female	816	61.54	61.54
Male	510	38.46	100.00
Total	1,326	100.00	

Table 3A. 4 Number of individuals in the selected sample based on Rural urban

Urban (1)	Frequency (2)	Percent (3)	Cumulative (4)
Rural	575	43.36	43.36
Urban	751	56.64	100.00
Total	1,326	100.00	

Table 3A. 5 Number of individuals in the selected sample based on Island

Java (1)	Frequency (2)	Percent (3)	Cumulative (4)
Non-Java	556	41.93	41.93
Java	770	58.07	100.00
Total	1,326	100.00	

Table 3A. 6 Number of individuals in the selected sample based on Health facility visit

Individual visit based on facility (1)	Frequency (2)	Percent (3)	Cumulative (4)
Private	424	31.98	31.98
Public	427	32.20	64.18
Other facility	475	35.82	100.00
Total	1,326	100.00	

Table 3A. 7 Number of individuals in the selected sample based on Education

Education (1)	Frequency (2)	Percent (3)	Cumulative (4)
Never attend school	65	4.90	4.90
Primary school	451	34.01	38.91
Secondary school	268	20.21	59.13
High school	390	29.41	88.54
Higher education	152	11.46	100.00
Total	1,326	100.00	

Table 3A. 8 Number of individuals in the selected sample based on Insurance

Insurance (1)	Frequency (2)	Percent (3)	Cumulative (4)
No insurance	1,070	80.69	80.69
Having insurance	256	19.31	100.00
Total	1,326	100.00	

Table 3A. 9 The summary statistics of selected variables

Variable (1)	Obs (2)	Mean (3)	Std. Dev. (4)	Min (5)	Max (6)
Dual practice physician ratio	1326	.7578327	.0713156	.65	.9286667
Age	1326	39.79336	15.67349	15	90
Individual income	1326	978777.5	1097321	20008.55	1.48e+07
Severity	1326	4.00905	6.000874	0	28
Travel cost to private facility	1326	15208.16	64847.81	0	1001500
Travel cost to public facility	1326	11298.08	53206.18	0	445000
Travel cost to other facility	1326	4562.387	6131.219	0	40000
Waiting time in private facility	1326	24.97888	55.11892	0	915
Waiting time in public facility	1326	30.44721	45.45028	0	360
Waiting time in other facility	1326	6.901961	10.69176	0	90
Price of treatment in private facility	1326	104243.4	298173.1	100	4025000
Price of treatment in public facility	1326	44716.44	99114.08	1000	770000
Price of treatment in other facility	1326	30748.11	11312.95	10000	100000

Table 3A. 10 Health care facility choice based on selected variables

Variables	Visit to health care facility			TOTAL
	Private	Public	Other	(percentage)
(1)	(2)	(3)	(4)	(5)
Insurance				
Yes	80	174	2	256
No	344	253	474	1070
Rural/Urban				
Rural	138	169	268	575
Urban	286	258	207	751
Java				
Java	274	239	257	770
Non-Java	150	188	218	556
Male/Female				
Male	177	149	184	510
Female	247	278	291	816
Education				
Never attend school	20	17	28	65
Primary school	124	158	169	451
Secondary school	67	91	110	268
High school	141	123	126	390
Higher education	72	38	42	152

Table 3A. 11 Quality component of private and public health care facilities

Variable	Private facility	Public facility
(1)	(2)	(3)
Number of private facility	1,597	969
Quality facility		
High	93%	78%
Low	7%	22%
Total	100%	100%
Quality of physician		
Get additional training	67%	86%
No additional training	33%	14%
Total	100%	100%
Quality of treatment		
Average of the vignette score	73	85
Std. deviation	35.32	10.85
Min	45	56
Max	122	117

Appendix 3B Results

Table 3B. 1A Goodness of fit (before and after bias correction)*

Fit stat	before correction	After correction
Log-likelihood		
Model	-1237.996	-1235.830
Intercept-only	-1454.929	-1454.929
Chi-square		
Deviance (df=1282)	2475.991	2471.660
LR (df=42)	433.866	438.197
p-value	0.000	0.000
R2		
McFadden	0.149	0.151
McFadden (adjusted)	0.119	0.119
Cox-Snell/ML	0.279	0.281
Cragg-Uhler/Nagelkerke	0.314	0.317
Count	0.523	0.532
Count (adjusted)	0.257	0.271
IC		
AIC	2563.991	2563.660
AIC divided by N	1.934	1.933
BIC (df=44)	2792.348	2802.397

Table 3B. 1B The result of VIF for the alternative model

Variables	Before correction		After correction	
	VIF	Tolerance	VIF	Tolerance
(1)	(2)	(3)	(4)	(5)
Health care visit	1.11	0.90	1.11	0.90
Dual practice	1.32	1.15	1.36	0.73
Age squared	1.28	0.78	1.64	0.61
Male	1.03	0.97	1.08	0.92
Education	1.44	0.70	2.68	0.37
Insurance	1.11	0.90	48.37	0.02
Ln Income	1.18	0.85	1.23	0.81
Severity	1.04	0.96	1.07	0.93
Urban	1.34	0.75	2.73	0.37
Java	1.20	0.83	1.20	0.83
Travel cost (private)	1.10	0.91	1.31	0.76
Travel cost (public)	2.11	0.47	2.27	0.44
Travel cost (Traditional healer/nurse/ midwife)	1.16	0.86	1.33	0.74
Waiting time (private)	1.10	0.91	1.10	0.91
Waiting time (public)	2.17	0.46	2.28	0.44
Waiting time (Traditional healer/nurse/ midwife)	1.27	0.78	1.27	0.79
Price (private)	1.03	0.96	1.04	0.96
Price (public)	1.14	0.87	1.15	0.87
Price (Traditional healer/nurse/ midwife)	1.23	0.81	1.24	0.81
Residual			44.77	0.002
Mean VIF	1.28		6.01	

*The VIF for the result in Table 3.5 and Table 3.6

Table 3B. 1C The LR tests for the model of before and after correction

Variables	Before correction chi2	df	P>chi2	After correction chi2	df	P>chi2
Dual practice	10.472	2	0.005	12.019	2	0.002
Age squared	6.587	2	0.037	1.340	2	0.512
Male	1.559	2	0.459	2.341	2	0.310
2. Education	1.764	2	0.414	1.542	2	0.463
3. Education	0.214	2	0.899	1.678	2	0.432
4. Education	2.236	2	0.327	.023	2	0.988
5. Education	5.145	2	0.076	.590	2	0.745
Insurance	261.282	2	0.000	24.551	2	0.000
Ln Income	7.455	2	0.024	8.293	2	0.016
Severity	2.820	2	0.244	1.521	2	0.468
Urban	14.540	2	0.001	0.998	2	0.607
Java	4.712	2	0.095	5.000	2	0.082
Travel cost (private)	3.327	2	0.189	0.734	2	0.693
Travel cost (public)	7.577	2	0.023	4.968	2	0.083
Travel cost (Traditional healer/nurse/ midwife)	0.040	2	0.980	0.605	2	0.739
Waiting time (private)	0.470	2	0.791	0.636	2	0.728
Waiting time (public)	3.667	2	0.160	2.146	2	0.342
Waiting time (Traditional healer/nurse/ midwife)	3.927	2	0.140	3.873	2	0.144
Price (private)	12.261	2	0.002	12.375	2	0.002
Price (public)	0.665	2	0.717	0.435	2	0.804
Price (Traditional healer/nurse/ midwife)	1.756	2	0.416	2.011	2	0.366
Residual				4.331	2	0.115

*The LR test for the result in Table 3.5 and Table 3.6

Table 3B. 1D The Wald tests for the model of before and after correction

Variables	Before correction chi2	df	P>chi2	After correction chi2	df	P>chi2
Dual practice	10.124	2	0.006	11.599	2	0.003
Age squared	6.592	2	0.037	1.343	2	0.511
Male	1.556	2	0.459	2.342	2	0.310
2. Education	1.705	2	0.426	1.520	2	0.468
3. Education	0.212	2	0.899	1.696	2	0.428
4. Education	2.212	2	0.331	0.023	2	0.988
5. Education	4.999	2	0.082	0.591	2	0.744
Insurance	96.176	2	0.000	22.163	2	0.000
Ln Income	7.393	2	0.025	8.221	2	0.016
Severity	2.861	2	0.239	1.540	2	0.463
Urban	14.415	2	0.001	1.000	2	0.607
Java	4.684	2	0.096	4.968	2	0.083
Travel cost (private)	2.994	2	0.224	0.625	2	0.732
Travel cost (public)	5.883	2	0.053	3.585	2	0.167
Travel cost (Traditional healer/nurse/ midwife)	0.040	2	0.980	0.607	2	0.738
Waiting time (private)	0.502	2	0.778	0.684	2	0.710
Waiting time (public)	3.771	2	0.152	2.163	2	0.339
Waiting time (Traditional healer/nurse/ midwife)	3.836	2	0.147	3.784	2	0.151
Price (private)	7.873	2	0.020	7.967	2	0.019
Price (public)	0.676	2	0.713	0.440	2	0.802
Price (Traditional healer/nurse/ midwife)	1.756	2	0.416	2.003	2	0.367
Residual				4.286	2	0.117

*The Wald test for the result in Table 3.5 and Table 3.6

Table 3B. 1E LR tests and Wald test of combining alternatives for model before and after bias correction

Before Correction						
Comparison	LR test			Wald test		
	chi2	df	P>chi2	chi2	df	P>chi2
(1)	(2)	(3)	(4)	(5)	(6)	(7)
private &public	141.838	21	0.000	108.055	21	0.000
private&traditional healer	201.303	21	0.000	106.776	21	0.000
public &traditional healer	325.054	21	0.000	76.235	21	0.000

* for the result in Table 3.5.

After correction						
Comparison	LR test			Wald test		
	chi2	df	P>chi2	chi2	df	P>chi2
(1)	(2)	(3)	(4)	(5)	(6)	(7)
private &public	142.778	22	0.000	108.782	22	0.000
private&traditional healer	205.565	22	0.000	110.350	22	0.000
public &traditional healer	326.283	22	0.000	77.536	22	0.000

* for the result in Table 3.6.

Table 3B. 1F Tests of IIA assumption for the alternative model

Before Correction									
Outcome	Hausman			Suest-based Hausman			Small-Hsiao		
	chi2	df	P>chi2	chi2	df	P>chi2	chi2	df	P>chi2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
private	2.320	15	1.00	26.799	22	0.219	68.763	22	0.000
public	-31.107	15	.	34.443	22	0.044	50.753	22	0.000
Traditional healers	1.315	15	1.00	16.204	22	0.806	20.348	22	0.561

* for the result in Table 3.5.

Before Correction									
Outcome	Hausman			Suest-based Hausman			Small-Hsiao		
	chi2	df	P>chi2	chi2	df	P>chi2	chi2	df	P>chi2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
private	2.831	16	1.000	27.676	23	0.228	78.277	23	0.000
public	-20.168	16	.	35.141	23	0.050	87.151	23	0.000
Traditional healers	-7.059	16	.	16.314	23	0.841	38.099	23	0.025

* for the result in Table 3.6.

Table 3B. 2A Relative risk ratio of the individual choice of health care facility (before bias correction)*

Variables	MNL Coefficient (standard error)	
	Private VS Public	Traditional healer/nurse/ midwife VS Public
(1)	(2)	(3)
Dual practice	.0267109	.6018549
Age squared	1.000107	.9999536
Male	1.210359	1.129302
Education		
Primary school	.714652	.6234561
Secondary school	.8322364	.8650845
High school	1.306295	.7382157
Higher education	2.299209	1.026267
Insurance	.2659113	.0062788
Ln Income	1.306125	1.185133
Severity	1.015239	.9965619
Urban	1.352792	.7331741
Java	1.267836	.9161535
Travel cost (private)	1.000000	1.000002
Travel cost (public)	1.000004	1.000008
Travel cost (Traditional healer/nurse/ midwife)	1.000002	1.000003
Waiting time (private)	1.001046	1.000277
Waiting time (public)	1.004395	1.001075
Waiting time (Traditional healer/nurse/ midwife)	.9862602	.996635
Price (private)	1.000000	.9999996
Price (public)	.9999977	.9999998
Price (Traditional healer/nurse/ midwife)	.999995	.9999902
Const	.3825609	.6163773

*Related with the result in Table 3.5

Table 3B. 2B Relative risk ratio of the individual choice of health care facility (after bias correction)*

Variables	MNL Coefficient (standard error)	
	Private VS Public	Traditional healer/nurse/ midwife VS Public
(1)	(2)	(3)
Dual practice	.0208843	.7014716
Age squared	1.000064	.9999853
Male	1.269007	1.086853
Education		
Primary school	.6014431	.7162286
Secondary school	.6158745	1.103311
High school	.9255363	.9801159
Higher education	1.562954	1.389154
Insurance	1.053338	.00163
Ln Income	1.335503	1.167787
Severity	1.012422	.9989869
Urban	1.111274	.8738356
Java	1.272778	.9085735
Travel cost (private)	1.000001	1.000001
Travel cost (public)	1.000005	1.000007
Travel cost (Traditional healer/nurse/ midwife)	1.000008	.9999979
Waiting time (private)	1.001133	1.000233
Waiting time (public)	1.003786	1.001566
Waiting time (Traditional healer/nurse/ midwife)	.9862964	.9965471
Price (private)	.9999977	.9999996
Price (public)	1	.9999998
Price (Traditional healer/nurse/ midwife)	.9999953	.9999895
Residual	.2450125	4.012515
Const	.3949425	.6291468

*Related with the result in Table 3.6

Table 3B. 3 Nested Multinomial Logit Model

Visits: 0. Private, 1. Public 2.Traditional/midwives/nurse Facility	Coefficient (standard error)
Price	-3.98e-07(2.43e-07)
Travel cost	-2.35e-06(1.54e-06)
Waiting time	-.002 (0.0010
Visit equations	
Non physician	
DP	0.723***(0.271)
Age2	-1.93e-04***(3.59e-05)
Male	-0.076(0.094)
Education	-0.098**(0.047)
Insurance	-3.829***(0.296)
lnIncome	0.089**(0.028)
Severity	-0.019***(0.007)
Urban	-0.464***(0.095)
Java	-0.075(0.091)
Physician	
	0(base)
Dissimilarity parameters	
/nonphysician_tau	
/physician_tau	
LR test for IIA (tau=1) chi2(2) = 0.01 Prob > chi2 = 0.9932	

Table 3B. 4 Multinomial Logit Model (simple)

Visits: 0. Private, 1. Public 2.Traditional/midwives/nurse 0.Private	Coefficient (standard error)	Relative Risk Ratio (standard error)
DP	-5.154***(1.223)	0.006(0.007)
Age2	1.28e-04*(6.97e-05)	1.000(6.97e-05)
Male	0.264*(0.160)	1.303(0.208)
Education		
2	-0.671(0.412)	0.511 (0.211)
3	0.019(0.451)	1.020(0.460)
4	-0.113(0.444)	0.893(0.396)
5	0.125(0.480)	1.1338(0.540)
Insurance	-0.667*(0.374)	0.513(0.192)
Income	0.037(0.096)	1.040(0.992)
Severity	-0.016(0.013)	0.984(0.013)
Urban	0.422***(0.165)	1.525(0.252)
Java	0.540***(0.162)	1.716(0.280)
Travel cost	5.31e-09(1.41e-08)	1.000(1.41e-08)
Waiting time	-0.002**(9.2e-04)	0.998(9.2e-04)
lnPrice	1.183***(0.092)	3.265(0.299)
Const	-9.098***(1.886)	1.12-e04(2.11e-04)
Traditional healer/nurse/midwives		
DP	-3.103***(1.040)	0.045(0.047)
Age2	1.19e-05(6.57-05)	1.000(6.57e-05)
Male	-0.186(0.150)	0.830(0.125)
Education		
2	-0.634*(0.380)	0.530(0.201)
3	-0.064(0.416)	0.940(0.390)
4	-0.547(0.414)	0.579(0.239)
5	-0.568(0.452)	0.567(0.256)
Insurance	-3.280***(0.742)	0.038(0.028)
Income	0.104(0.091	1.101(0.100)
Severity	-0.005(0.150)	0.995(0.013)
Urban	-0.445***(0.150)	0.641(0.096)
Java	-0.022(0.150)	0.978(0.150)
Travel cost	4.10e-09(1.41e-08)	1.000(1.41e-08)
Waiting time	-0.029***(0.003)	0.971(0.003)
lnPrice	0.322***(0.083)	1.380(0.115)
Const	-0.424(1.745)	1.380(0.115)
n	1615	0.654(1.141)
Pseudo R^2	0.2060	
Log likelihood	-1369.6966	

$* p \leq 0.1, ** p \leq 0.05, *** p < 0.01$

Note: This result is the main model using the simplified variable of travel cost, waiting time, and price. These variables uses the observed data from the individuals without classified based on the health care facilities.

Table 3B. 4A Post estimation for the simplified model*

Suest-based Hausman test of IIA assumption	Visit: Private Public Traditional	Chi2(p>chi2) 18.376 (0.302) 44.220 (0.000) 48.057 (0.000)
Small-Hsiao test of IIA	Visit: Private Public Traditional	Chi2(p>chi2) 8.931 (0.916) 28.211 (0.030) 25.909 (0.055)
AIC	2803.393	
BIC	2975.780	

*In Table 3B.4

Table 3B. 5A Estimation of Probit model for the first stage of SRI

Variable	Model A	Model B
phydppropr~n	.89368203	.98988412
	.66399834	.6582022
age2	.00008966	.00010451
	.00003746	.00003581
sex		
1:Male	-.09062152	-.13299161
	.08926682	.08801477
educ		
2	.54666952	.55594324
	.25809488	.25762998
3	.88354458	.89833022
	.27331497	.27285889
4	.93983404	1.0131108
	.27433281	.27206303
5	.99813633	1.0969986
	.28637738	.28414768
probhat	2.9558113	
	.84579761	
lnrpcenew	-.08239745	-.07070134
	.0567135	.05613118
severity	.00656586	.00823475
	.00714671	.00704472
urban		
1	.53014369	.54320102
	.10143578	.10031415
java		
1	.03892698	.01614104
	.09612662	.09397274
trcostmedd~0	-.00001592	-.00001653
	4.436e-06	4.375e-06
trcostmedd~1	-2.982e-06	-3.136e-06
	1.561e-06	1.567e-06
trcostmedd~2	-.00001673	-.00001451
	7.430e-06	7.296e-06
waitin~afac0	-.00277659	-.00288731
	.00186566	.00182602
waitin~afac1	.00242211	.00203682
	.0014965	.00146397
waitin~afac2	-.00115958	-.00146916
	.00435809	.00429431
costmeddes~0	1.592e-07	2.300e-07
	2.973e-07	2.687e-07
costmeddes~1	-5.700e-08	3.339e-08
	5.766e-07	5.623e-07
costmeddes~2	-3.866e-06	-1.947e-06
	4.119e-06	4.057e-06
selfemploy		
1	.00285768	
	.1254333	
marstatnew		
1		.08038291
		.09891584
_cons	-1.9803141	-1.7913015
	.96513544	.95760592
N	1326	1326
ll	-577.89894	-586.98839

legend: b/se
Model A is using self-employment as instrumental variable, while Model B uses marital status.

Table 3B. 5B Estimation of Probit model for the second stage of 2SRI

Variable	Model B	Variable	ModelB
Private		Traditional healer/nurse/midwife	
phydppropr~n	-3.6432188	phydppropr~n	-.3056883
	1.2574164		1.2277298
age2	.00009935	age2	-9.669e-06
	.00007831		.00007825
sex		sex	
1:Male	.19964335	1:Male	.08047534
	.16280169		.16606278
educ		educ	
2	-.36864364	2	-.31547813
	.42889441		.40849293
3	-.23945019	3	.12052792
	.54094627		.50877117
4	.20538631	4	.00973227
	.57559175		.54809639
5	.76297785	5	.36689398
	.63453419		.61465423
insurance		insurance	
1	-1.1016061	1	-6.465781
	1.5941125		1.7331845
lnrpcenew	.27124857	lnrpcenew	.1531756
	.10148345		.10435983
severity	.0145614	severity	-.0010314
	.01255033		.01344427
urban		urban	
1	.26873933	1	-.12816098
	.27920596		.26867915
java		java	
1	.23830672	1	-.09627905
	.16486484		.16843786
trcostmedd~0	2.679e-07	trcostmedd~0	1.241e-06
	1.947e-06		1.817e-06
trcostmedd~1	4.535e-06	trcostmedd~1	7.467e-06
	4.394e-06		4.437e-06
trcostmedd~2	2.681e-06	trcostmedd~2	-2.279e-06
	.00001392		.00001477
waitin~afac0	.00106485	waitin~afac0	.00022535
	.00157846		.00141285
waitin~afac1	.00430295	waitin~afac1	.00163081
	.00281459		.00287782
waitin~afac2	-.01381841	waitin~afac2	-.00347479
	.00749769		.00788286
costmeddes~0	-2.263e-06	costmeddes~0	-3.931e-07
	9.907e-07		2.107e-07
costmeddes~1	3.475e-07	costmeddes~1	-1.986e-07
	8.051e-07		7.920e-07
costmeddes~2	-5.014e-06	costmeddes~2	-.00001028
	6.865e-06		7.413e-06
resid3	-.22692507	resid3	1.4273629
	1.6146466		1.606329
_cons	-.97094023	_cons	-.50516827
	1.6838765		1.7465425
Statistics			
N	1326		
ll	-1237.2925		

legend: b/se
Parameter estimates using Multinomial Logit model as a result of second stage of 2SR

Table 3B. 5C Goodness of fit for multinomial logit after bias correction

Instrumental variabel :	marital status	self-employment
Log-likelihood		
Model	-1237.293	-1235.830
Intercept-only	-1454.929	-1454.929
Chi-square		
Deviance (df=1280)	2474.585	2471.660
LR (df=44)	435.272	438.197
p-value	0.000	0.000
R2		
McFadden	0.150	0.151
McFadden (adjusted)	0.118	0.119
Cox-Snell/ML	0.280	0.281
Cragg-Uhler/Nagelkerke	0.315	0.317
Count	0.529	0.532
Count (adjusted)	0.267	0.271
IC		
AIC	2566.585	2563.660
AIC divided by N	1.936	1.933
BIC (df=46)	2805.321	2802.397

Table 3B. 6 Odds Ratio and Robustness check for the individual choice of health care facility with quality factor

Variable	Model 1	Model 2
Dual practice	25.733(48.420)	52.643(92.372)
Age	1.000(5.41e-05)	1.000(0.000)
Male	0.907(0.125)	0.865(0.124)
Education		
Primary school	1.953(0.693)	1.462(0.544)
Secondary school	1.764(0.677)	1.216(0.491)
High school	1.130(0.427)	0.783(0.312)
Higher education	0.652(0.264)	0.500(0.214)
Insurance	4.106(0.619)	3.715(0.601)
Income	0.713(0.060)	0.817(0.071)
Severity	0.987(0.012)	0.991(0.012)
Urban	0.966(0.156)	0.861(0.143)
Java	0.606(0.222)	0.681(0.260)
Travel cost (private)	1.000(2.19e-06)	1.000(2.63e-06)
Travel cost (public)	1.000(5.34e-07)	1.000(8.54e-07)
Waiting time (private)	1.002(0.001)	1.000(0.001)
Waiting time (public)	1.000(0.002)	1.000(0.002)
Price (private)	1.000(1.04e-10)	1.000(9.77e-07)
Price (public)	1.000(4.02e-10)	1.000(6.92e-07)
Quality facility (private)	0.651(0.290)	1.320(0.509)
Quality facility (public)	1.066(0.280)	1.145(0.264)
Quality physician (private)	0.039(0.092)	0.847(1.342)
Quality physician (public)	9.115(20.599)	0.454(0.512)
Quality treatment (private)	1.045(0.044)	1.000(0.022)
Quality treatment (public)	0.841(0.076)	1.000(0.041)
Cons	1028306(5132220)	2220.218(8056.741)
n	1116	998
Log likelihood		

Table 3B. 7 The Link test, Hosmer and Lemeshow test, and AIC/BIC test for the individual choice of health care facility with quality factor

Test	Model 1	Model 2
Link test	0.100(0.064): P>|z = 0.128	0.131(0.09): P>|z = 0.116
Hosmer and Lemeshow	Prob>chi2 = 0.439	Prob>chi2 = 0.445
AIC	Logit = 1390.082	Logit = 1280.502
AIC divided by N	Logit = 1.246	1.283
BIC	Logit = 1510.502	Logit = 1403.146

Model 1 uses price data taken from a certain treatment fee in the facility. Model 2 uses price variable from patient’s expenditure when visiting health care facility.

Table 3B. 8   Logit Model on increasing demand framework

Seeking health care: 0. No, 1. Yes		Coefficient (standard error)
Dual Practice		-.0494657 (.1147896)
Age2		.0001344***(.0000191)
Male		-.6614524***(.0464416)
Education		
	2	.2812925***(.109019)
	3	.3694339***(.120411)
	4	.397100***(.120646)
	5	.4001992***(.132717)
Insurance		.213915***(.0454313)
Income		.2127471***(.0284639)
Severity		.0881866***(.0041511)
Urban		-.055707(.0514498)
Java		.09944016(.0492451)
Travel cost to private		-3.40e-07(3.93e-07)
Travel cost to public		1.79e-06***(6.22e-07)
Travel cost to nurse, midwife, traditional healer		-.0000138***(3.97e-06)
Waiting time private		-.0007987**(.0003671)
Waiting time public		-.0004836(.0007339)
Waiting time nurse, midwife, traditional healer		.0025425(.0024075)
lnPrice		5.05e-08(7.60e-08)
		-3.77e-07(2.56e-07)
		-1.05e-0(1.96e-06)
Const		-4.794955***(.4034541)
n		13,885
Pseudo R^2		0.0658
Log likelihood		905.53

$* \, p \leq 0.1, ** \, p \leq 0.05, *** \, p < 0.01$

Note: This model tests our cautions on whether dual practice affects the increasing demand of health care. This table is a supporting analysis for discussion in sub chapter 3.8. See also Figure 3.6 in the text.

Appendix 3C Measuring the quality assessment

Our research uses three components of quality that will affect individual's decision on health care facility between public facility or private facility. The first component is quality of facility that is a composed index measured by the cleanness aspect that can be seen by the interviewer and health care instruments provided in the facility. The source of the information comes from IFLS public community health center questionnaire and IFLS private facility questionnaire.

To compose the quality facility score, we sum up all the response for all items and get the total score. The score then divides into binary codes, code 1 indicates the quality of facility is good, and 0 indicates the quality of facility is not really good. The facility has good quality facility if the cleanness items are all in clean indicator, and health care instruments are available in the facility. The quality of facility is categorized is not very good if one or more cleanness items are indicated dirty and health care instruments are not available completely in the facility.

Table 3B. 8 Cleanness aspect from public facility and private facility questionnaire

Public facility questionnaire BOOK Public community health center Section F		Private facility questionnaire BOOK Private facility Section E	
IFLS Questionnaire	Question	IFLS Questionnaire	Question
F1	How clean is the floor in this room? Dirty .... 1 Clean .... 3 Dirty = if a lot of, food remnants, scattered garbage is found.	E1	How clean is the floor in this room? Dirty .... 1 Clean .... 3 (dirty=if a lot of dust, food remnants, scattered garbage are found)
F2	How clean are the walls in this room? Dirty .... 1 Clean .... 3 Dirty = if lots of spider webs, scribblings, moisture or paint peeling off	E2	How clean are the walls in this room? Dirty .... 1 Clean .... 3 (dirty=if many spider webs, scribbling, dust, moisture, paint peeling off are found)
F2b	Does the room have: G. Trash can Yes .... 1 No 3	E5	What provisions are made for washing hands in this room? Washing stand with running water ...... 1 Wash basin with clean water ... 3 Nothing available 6
F5	What provisions are made for washing hands in this room? Wash stand with running water …………………… 1 Wash basin with clean water…………………… 3 Not available 6	E6	Is there a waste basket in the room? Yes .... 1 No 3

Table 3B. 9 Health care instruments from public facility and private facility questionnaire

Public facility questionnaire BOOK Public community health center Section E		Private facility questionnaire BOOK Private facility Section C	
Type of instruments (E1 type)	The number of instruments owned by this Puskesmas that are in good repair? > 0 ....1 0 3	Kinds of instruments (C1 type)	Do you have […] that is still function properly? 3. No 1. Yes
a. Regular stethoscope		a. Regular stethoscope	
b. Stethoscope for pregnant mothers		b. Stethoscope to examine pregnancy	
c. Blood pressure meter		c. Blood pressure monitor	
d. Sterilization/autoclaves		d. Sterilization/autoclaves	
e. Scales for adults		e. Adult scales	
f. Scales for infants		f. Baby scales	
g. Measures for body height		g. Measurers for body height	
h. Thermometer		h. Thermometer	
i. Beds		i. Beds	
j. Delivery kit		j. Normal delivery set	
k. Forceps		k. Forceps	
l. Vaginal Speculum		l. Vaginal Speculum	
m. Sahli Set		m. Sahli Set	
aa. Microscopes		aa. Microscopes	
ca. Syringes		ca. Syringes	
da.Cholesterol test kit		da. Cholesterol test kit	
ea. Blood sugar test kit		ea. Blood sugar test kit	

Table 3B. 10 Health care instruments from public facility and private facility questionnaire

Public facility questionnaire BOOK Public community health center Section E		Private facility questionnaire BOOK Private facility Section C	
Type of instruments (E2 type)	Does this facility have […]? 3. No 1. Yes	Kinds of instruments (C2 type)	Does this practice place have a […]? 3. No 1. Yes
a. Antiseptic : 1. Alcohol 2. Betadine 3. Whitfield cream		a. Antiseptic : 1. Alcohol 2. Betadine 3. Whitfield cream	
b. Bandages		b. Bandages	
c. Gloves		g.Gloves	
d. Infuse instruments and needles		f.Infuse instruments and needles	

<table>
<tr><td colspan="2">Public facility questionnaire
BOOK Public community health center
Section E</td><td colspan="2">Private facility questionnaire
BOOK Private facility
Section C</td></tr>
<tr><td>Type of instruments
(E2 type)</td><td>Does this facility have […]?
3. No 1. Yes</td><td>Kinds of instruments
(C2 type)</td><td>Does this practice place have a […]?
3. No 1. Yes</td></tr>
<tr><td>h. Pregnancy test (strip)</td><td></td><td>l.Pregnancy test (strip)</td><td></td></tr>
<tr><td>j. Glucose urine tests (strip)</td><td></td><td>n.Glucose test (Strip)</td><td></td></tr>
<tr><td>m. Cholesterol test kit</td><td></td><td>t.Cholesterol test kit</td><td></td></tr>
<tr><td>n. Blood sugar test kit</td><td></td><td>u.Blood sugar test kit</td><td></td></tr>
</table>

Quality of treatment

The quality of treatment comes from composed index of vignette questionnaire. The survey staff will interview the physician using several study case that describes the patient's symptoms. The physician will be asked to mention how to approach several questions to patient in order to find the correct diagnosis such as asking the current patient's condition, patient's medical history and behavior, physical examination, and laboratory examination. Physician with good quality of treatment will treat the case simultaneously while the not very good physician needs to be prompted using questionnaire by the interviewer.

There are four sections of vignette available in the IFLS questionnaire, curative care for adult, curative care for adult with diabetes, curative care for children, and prenatal care. We only use one of the vignettes which is curative care for the adult because most facilities provide this treatment and the rate of response is quite high. The physician indicates providing good treatments if most of the answers are mentioned spontaneously without being prompted by the interviewer. The summations of all score in the vignette will be used in our regression model of quality affect. We underline that the lower score indicates that the quality treatment is good as physician responses simultaneously for almost the case to diagnose the study case. While the higher score means that quality treatment is not really good because physician mostly have to be prompted in diagnosing the study case during the interview.

Table 3B. 11 Vignette for adult care in public and private facility

Question Items 1.mentioned spontaneously 2.prompted 3.prompted	Public facility questionnaire	Private facility questionnaire
Mr.Widyono came to this facility with a complaint of coughing and a fever. Now I would like to ask you exactly what you would do for this patient.	H10	HPR10
What questions do you ask the patient about his cough and fever, and current health?	H11.	HPR11
How long have you suffered from this condition?	H11a	HPR11a
Any shortness of breath?	H11b	HPR11a
Is there any blood when you cough?	H11c	HPR11a
What was the color of the sputum?	H11d	HPR11a
Do you have any pain in the chest?	H11e	HPR11a
Any weight loss?	H11f	HPR11a
Is cough productive?	H11g	HPR11a

Question Items 1.mentioned spontaneously 2.prompted 3.prompted	Public facility questionnaire	Private facility questionnaire
Any contact with others with respiratory problems/TB?	H11h	HPR11a
Any night sweats?	H11i	HPR11a
What medicine have been taken?	H11j	HPR11a
Any fever?	H11k	HPR11a
Feeling weak?	H11l	HPR11a
Any headache	H11m	HPR11a
Losing appetite?	H11n	HPR11a
Nauseous?	H11o	HPR11a
What questions do you ask the patient about his medical history and behavior?	H12	HPR12
Previous TB case or took TB medicine?	H12a	HPR12a
BCG immunization or ever positive PPD? *Note: PPD = Purified Protein Derivative or Mantoux, examination of TBC	H12b	HPR12b
History of asthma or COPD? *Note: COPD = Chronic Obstructive Pulmonary Disease, chronic lungs disease	H12c	HPR12c
History of cardiac problems?	H12d	HPR12d
History of malignancy or gastric surgery?	H12e	HPR12e
Medications recently or currently taking?	H12f	HPR12f
Drug allergies?	H12g	HPR12g
Smoking history?	H12h	HPR12h
Number of packages/quantity of smoking?	H12i	HPR12i
Alcohol use?	H12j	HPR12j
Live alone or with others?	H12k	HPR12k
Employment?	H12l	HPR12l
Family health history?	H12m	HPR12m
Sanitation, ventilation at home?	H12n	HPR12n
What do you do when you conduct a physical examination of the patient?	H13	HPR13
Examine general appearance?	H13a	HPR13a
Take temperature?	H13b	HPR13b
Listen to respiration?	H13c	HPR13c
Check for sore throat?	H13d	HPR13d
Palpitate / feel throat / lymph nodes?	H13e	HPR13e
Is chest indrawing?	H13f	HPR13f
Palpate abdomen? *Note: palpation = examination by palpating and pressing	H13g	HPR13g
Pulse *Note: vital signs = breath, pulse *Note: IPPA = Inspection, Palpation, Percussion, Auscultation	H13h	HPR13h
Blood pressure	H13i	HPR13i
What laboratory examinations would you conduct?	H14	HPR14
Chest x-ray	H14a	HPR14a
PPD ormantoux test	H14b	HPR14b
Sputum exam for TB	H14c	HPR14c
Routine bloodwork	H14d	HPR14d

Question Items 1.mentioned spontaneously 2.prompted 3.prompted	Public facility questionnaire	Private facility questionnaire
Liver function	H14e	HPR14e
CD4/cell count *Note: blood test to see the immune system	H14f	HPR14f
Urinalysis	H14g	HPR14g

Quality of physician

The quality physician is measured using the identification whether physician have received additional training since graduated for the medical school. The code from the questionnaire is 3 if physician have never received additional training since graduated while code 1 if physician have received additional training since graduated. We recode the code 3 into 0 in order to match with the regression process in the quality model.

Table 3B. 12 Question for physician quality

Public facility questionnaire BOOK Public community health center Section E		Private facility questionnaire BOOK Private facility Section C	
H19. Have you received additional training since you graduated?	No .... 3 Yes 1	HPR5. Have you received additional training since you graduated?	No .... 3 Yes 1

Chapter 4

Why Physicians Engage in Dual Practice?

Evidence from a Developing Country

Abstract

This research studies dual practice in two aspects. The first is the direct effect of physician's valuation on dual practice by analysing the factors that affect physician's decision to get involved in the dual job activity. The second is the indirect effect on equilibrium price of private sector from dual practice existence and health insurance coverage. The study takes Indonesia as a case of study and uses the Indonesian Family Life Survey (IFLS) 5 in 2014. Using alternative specific conditional logit and multinomial logit model the results show that income and experience affect the physician's decision of dual practice. The indirect effect of dual practice shows that the existence of dual practice might decrease price level, while more population under insurance coverage increases the price of treatment.

Keywords:dual practice, physician, choice, Indonesia

4.1 Introduction

Dual physician practice where the doctor can work in both public and private facilities is a common practice to increase health care access in many developing countries. Although this double job is broadly happening, its presence is rarely getting attention, as it is hardly accompanied by the regular evaluation. Current reports show a substantial amount of physicians engage in dual practice such as reported by Gruen, Anwar, Begum, Killingsworth, & Normand (2002) in Bangladesh, Berman and Cuizon (2004) in Indonesia, and Prakongsai, Chindawatana, Tantivess, Mugem, & Tangcharoensathien (2004) in Thailand.

Our research analyses how physicians value dual practice activity by describing factors that influencing physician's decision of working place, whether they choose to work in public sector, in a private facility or engaged in dual practice. The latter term is when physician works in public facility and private facility. The study emphasizes the entry step of physicians into the market of health care supply. The study uses Indonesia as case of study. Public physicians might open private practice in their own place or work in private health care facilities such as private clinics or private hospital after their public working hours. The private practice by dual practice physician refers to private facility that completely different in term of location or management from public facility and not refers to public physician who opens the private practice using public facilities that are also commonly found in health care system. For example that is practiced in Austria and Ireland where public physician can serve private patient in special section of hospital (Kiwanuka et al, 2011). In Indonesia, it is forbidden for public physician to use public facility for their private practice. Factors affecting dual practice decision consist of income, physician's residence, potential demand factors and individual physician's characteristics. The research will propose further possible policies regarding dual practice in Indonesia's setting by considering factors that importantly influence physicians on working in one sector or holding two jobs. We provide the simulation of increasing public physician salary that affecting the decision on being a dual practitioner. We find that while additional income is one of the motivations for a physician to engage in dual practice, physician characteristics such as working experience and geographical location influence the decision to work as dual practitioners. Dual practice is important in Indonesia because physician highly value the practice especially physicians at the beginning of the career. The simulation on increasing the public salary shows it has to be increased into significant level to keep physician working in public sector if the government of Indonesia wants to diminish dual practice physician from the system. The second purpose of the paper is to analysis the change of the price equilibrium related with the dual practice in the health care system. This analysis is related with our analysis in Chapter two. It shows that the existing dual practice lead into different price equilibrium because of change in demand as a direct consequence of dual practice. The empirical result using Indonesian data on dual practice and price of outpatient care shows that price of health care treatment in private practice is decreasing along with the increasing percentage of dual practice physician in the area. On the other hand, insurance coverage has positive relationship with the price of treatment.

In most developing countries due to many limitations, dual practice is allowed without strict regulation. In Indonesia, the dual practice law first appeared in the 1970's as part of health care access enhancement. This system allows the public physician to have private practice or work in private facilities after his public working hour. The increasing percentage of outpatient health utilization in Indonesia, from 15.1% in 1996 to 33.7% in 2006 is partly because of the existence of health workers dual practice such as physician, midwife, and nurse (Rokx, Schieber, Harimurti, Tandon, & Somanathan, 2009). The change in Indonesia health system towards Universal Health Coverage (UHC) program and the growing of private sector lead to the importance of the review of the presence physician regulation especially related with dual practice. To propose new policy, one way to start with is to consider how physician decides his working place and because the physician is the central player in the health care system that undoubtedly affected with the new policy.

Concern regarding dual practice is that it might bring negative impact to public service provider. Some of common disadvantages of dual practice physician are a high rate of physician's absenteeism on the public working place and the decreasing quality treatment in public sector because public physician put more effort on his private practice rather than his public work (Hipgrave & Hort, 2014). Besides providing more services for people, dual practice seems to have a positive influence in term of public quality treatment. Theoretical work by Gonzalez (2010) points out that the quality of treatment in public facility increases because physician builds his reputation in public sector by putting higher efforts of service to the public facility rather than service of his private facility. This will attract more patients to physician's private practice. The unofficial report from Indonesian local newspaper indicates that a dual physician gives more priority on his private practice in term of time or quality. A study using different wave of IFLS by Rokx, et al., (2010) presented a quality study between public and private facilities using vignette questionnaires filled by the physicians. The result shows difference quality in adult treatment, maternal, and children care. The public facility has better quality on maternal care while the private facility has better quality treatment on adult and children care. We explore specifically the indication of different quality among dual practice physician and non-dual practice physician using available data. Based on data processing using Indonesian Family Life Survey (IFLS) 5, we provide a simple difference analysis of physician quality based on the dual practice involvement. The result shows that dual practice physicians have better quality on providing adult care compare to physicians working in private sector only. We measure the quality component using the physician's response on diagnosing a particular symptom. Dual practice physicians might have better quality than private physician because they have more opportunity to get additional training offered by public sector. Using the same data, the analysis on total working time and time devoted to serving patients in public facility show that dual practice physicians in public facility have lower total working hours and time of service patients compared to physicians of non-dual practice in the public facility. This result indicates a different behaviour between dual practice physician and non-dual practice physician in the public sector that affects the working hours between dual practice physician and non-dual practice physician.

The private sector in Indonesia is growing and it is essential for health care provision. The existence of dual practice regulation allows doctors to work flexibly from public to private sector. A private facility such as a private hospital or private clinics usually consists of a physician who has a primary job in the public sector and physician that purely working in private sector. This condition creates complications for the health authority to figure out the scale of private provision served by physicians. The number of physicians working in private increased in almost 10,000, from 19,967 physicians in 1996 to 29,634 physicians in 2006 (Rokx, et al., 2010). Following the typical pattern, the highest increases in the number of physicians working in private service happen more in an urban area, where the physician ratio is 28 physicians per 100,000 residents compared to only 4 physicians per 100,000 residents in the rural area. The large differences of physician ration between urban and rural areas indicate that dual practice role in urban area might be no longer as health care enhancement because in fact the number of physician compare to population in urban area is already high so that people can access to health care services more easily then people in rural area. This indicates that dual practice policy in Indonesia should get more attention from decision maker because of situation changing related with dual practice role in health care system.

Dual practice study of developing country is closely related with residence areas and potential demand of health care. Theoretically the potential demand relates with the health care supply, such as the number of people who need health care with the numbers of facilities or physicians available in the area. In Indonesia case, the leading causes of differences physician ratio among areas are from the geographical conditions and the unevenly distributed population. For example, provinces in Java Island have more physicians to provide health care services, while physicians in provinces of eastern part of Indonesia are still lack of number. The ratio discrepancy also occurs between rural and urban areas, while around 70% of the Indonesian population lives in rural areas, but only 20% of the physicians base their practice in the countryside. Among the total number of

9,731 public community health services, 5% of them still do not have a physician and around 9% of the public facilities have a physician, but living far away from the facility because of its remoteness. The Government of Indonesia then implemented systematic programs to strengthening public sector provision. The latest regulation on public physician recruitment in 2013 also puts dual practice as one of the advantages of working in the public sector. A public physician will get a higher salary level and a shorter assignment period if the physician undertakes a placement in remote areas. Other attractive factors for being a public physician are additional living allowance from regional government and further specialist education opportunities. Another attempt to manage the quality treatment of physician, regarding the latest regulation in 2011 health authority issues a practice permit for a physician that allows physician to have three practices at most, whether in a public facility, a private facility or by owning a private practice. A physician can get several career opportunities after he finishes his training and takes the clinical path. They can work as a public physician, an employee in a private facility, or establish their own private practice. A physician has to acquire a practice permit that is issued by the health authority. The limitation however is not strictly monitored and is not accompanied with the punishment system.

Dual practice is categorized as an illegal practice in Canada. Governments in Spain, Portugal, and Italy offer rewards for physicians who work solely in public, while in Austria and Ireland, physicians are encouraged to perform private activities. In general, dual practice regulation can be divided into banning the dual practice, allowing the dual practice, allowing dual practice with some limitations in term of income or working hours. Theoretical works have already discussed the different effects of dual practice regulation - Brekke and Sorgard (2007), Kuhn and Nuschelar (2013), Gonzales and Stadler (2013). There is still no consensus on whether its net effect is positive or negative. This is reflected by the different approaches to regulation of dual practice among countries, although these differences are also related to the heterogeneity of health care systems and environments (Hipgrave & Hort, 2013).

We use a health facility dataset containing information on health workers working in public and private facility. The IFLS data is one of the datasets that provides information on the physician. The survey is a longitudinal survey, and we use the IFLS wave 5 which is the latest wave that fielded in 2014. The data takes public community health centre, private clinics, and private practice to represent the nearest health facility to the community. There are several steps to draw a physician's sample, as the main purpose of the survey is not focusing on the physician but on the facility. The difficulties arise especially for the private clinics as the physician is not commonly involved in the interview process, where it is mostly a nurse or the front desk officer answering the survey. To guarantee the validation process, we eliminate private clinics which consist of more than one physician. We only include the single private physician practices, which consist of one physician representing a private facility sample. So that the physicians in the sample have complete information needed for our research.

The demand and supply identification starts by writing the demand function and supply function in a simple form, $Q_t^d = \alpha_0 + \alpha_1 P_t$, $Q_t^s = \beta_0 + \beta_1 P_t$. The P_t is the price, and $\alpha_0, \alpha_1, \beta_0, \beta_1$ are the structural parameters. In this model, there is no exogenous variable. Setting an equilibrium condition as $Q_t^d = Q_t^s$ there are only two reduced form coefficients to determine four structural parameters. The model is said to be under identified because there are many combinations of values of the four structural parameters that consistent with the two values of the reduced form coefficients. The broad point of demand and supply that is shown above is that we usually see only the equilibrium point of demand and supply. Therefore we will need system of equation or instrument variable to identify each side. However, the demand part in our case is more likely linked to the health shocks that are independent to supply than anything else Our study is closer to decision entry into a market (Schaumans & Verboven, 2008). It is not how much to supply in terms of treatment to patients (i.e. time spent with each patient). The decision to be or not to be a dual practice physician is a decision of entry into a market.

Our research identifies income, physician's residence, potential demand factors, and individual physician's characteristics that are involved in the physician decision of working place. The IFLS data provides information on public wage, revenue from practice profit, and other primary jobs. We use an estimation process with physician characteristics to estimate public wage for a private physician, and profit revenue for the public physician. We provide simulations based on the estimation result to show the importance of public salary for the physician and the decision of becoming a dual practitioner. We propose a policy that involved the rise of public wage into several scenarios.

The paper is structured as follows. Section 4.2 consists of selected literature review and testable hypothesis. Section 4.3 we describe the institutional setting and the database. Section 4.4 presents the identification strategy. The descriptive statistics and estimation process in completing income data is presented in Section 4.5. Section 4.6 shows the results. Section 4.7 is the policy exploration on salary. Section 4.8 provides the effect of dual practice and insurance to price analysis. The final section concludes.

4.2 Literature review

The physician is one of the players in health care system. The dual practice policy is closely related to the physician decision of working place, whether public, private, or both. The expectancy theory of motivation in Lawler III and Suttle (1973) reveal that job preference of dual job holding practitioners could be seen as a conscious decision based on the expected result of alternative behaviour. In the relationship between employee and employer, as labour, the individual prefers to work more hours in their highest-paying job rather than hold multiple jobs (Lang, 1994). The employers restrict their employees not to be involved in another job, to keep their attention at work, and the ordinary workers cannot work in two firms at the same place (Holmstrom & Milgrom, 1991).

The doctors' behaviour is influenced by an internal trade-off between two rewards system: those derived from their government job and those derived from private practice (Gruen, et al., 2002). Based on Evans (1974), the extent to which dual job holders pursue income maximizing behaviour or to merely achieve a target income will depend on a range of factors, including the elasticity of demand for the services offered and the degree of competition in the market segment. Besides, professional ethics and the income level from government earnings play a role in these decisions. The form and prevalence of physician's simultaneous engagement in public and private clinical activities critically depends on local factors linked to the health system's governance (regulation and implementing institutions), as well as to the structure of the market for physician services: supply, demand, and product (Russo, McPake, Fronteira, & Ferrinho, 2014).

Previous research mentioned other factors that also become motivation for physician in engaging dual practice activities. Gonzales (2004) describes that an improving professional practice as an additional factor, while Chawla (1996) adds that complementarities between public and private sector affect physician's engagement in the dual practice. The other motivations are: expanded or complementary use of professional skills, clinical autonomy, broader professional contact, reputation building, and flexibility of private practice (Garcia-Prado & Gonzales, 2011). Humphrey and Russel (2004) identify the motivation behind the dual practice as the access to alternative facilities. They also mention that physicians involve in dual practice to relief pressure and lower appreciation in public environments. The summary of previous literature is available in Table 4A.1 of Appendix 4A. We limit our analysis to factors that affect physician's decision on dual practise. The study is based on data availability particularly Indonesian's data on dual practice activities that becomes our study case such as income, physician's residential, potential demand, and physician's individual characteristics.

Generating additional income is believed as physician's primary motivation to engage in dual practice. Van Lerberghe, Conceiao, Van Damme, & Ferrinho (2002) describe a dual practice as individual coping strategy for the health care personnel in dealing with unsatisfactory living and working conditions. This refers to the usual situation of unfair salaries for physicians working in public sector that are usually happened in low and middle income countries. Involving in dual practice means physicians can get additional income from private sector beside their main job in public facility. Income is a fundamental motivation that drives physicians to top up the individual income level to achieve a standard of living closer to what they expect. The study by Roenen, Ferrinho, Van Dormael, Conceiao, & Van Lerberghe (1997) in sub-Saharan Africa identify some dual job activities by public physician driven by the motivation to get extra income. The common dual job activity for physician is developing a private practice, with different kinds of format such as formal private clinic, home visit service, and contract with private firm. The dual job is financially rewarding as doctor's monthly income could be doubled with 15 days of private practice, even it could be achieved with 10 hours of private practice. Other source of extra income might also come from the non-medical activity such as agricultural work especially in rural area where the market for private sector is too small. Besides that, physicians also reported to use public resources for their private practice. Study of physicians in Portuguese-speaking African country by Ferinho, et al., (1998) emphasize that income is important reason in motivating physician's dual job. The reasons that mostly stated by physicians in engaging dual job are to meet the living cost and to support the extended family. The inadequate public salary in many African countries is a well-known fact that underlying the physician's effort to find additional source of income. Public salary is still the main resource of total physician income, about 55% of median in rural areas but only 10% median in urban area. In the latter case, the private sector hold almost 65% median of the physician's total income. The salary in public sector appears to be important determinant influencing physician's decision on dual practice activities. In more developed country setting, Askildsen and Holmas (2013) using Norway hospital physician data reveal that the increase of 11% salary increased the public physician supply and reduce the dual practice. The study analyses the effect of the increasing salaries for extended working hours and overtime work policy to tackle the brain drain from public to private hospital. Using different data set and methodology, Johannessen and Hagen (2014) show that income motive is important factor that attracts physician to involve in dual practice. The detailed result shows that the most significant internal hospital factor for choosing dual practice is high wages of extended working hours in public facility. The increasing wage level is significantly reducing the odds for physician being dual practice.

There are limited evidences that show the relationship between individual characteristics of physicians and dual practice activities. Variables such as physician being a migrant worker, being on temporary contracts, and doing shift works are important (Ferrinho, Van Lerberghe, Fronteira, Hipolito, & Biscaia, 2004). They argue that the physician characteristics are important determinants for dual practice decision but the evidence is not conclusive or generalizable. The general results suggest that dual practice does not depend so much on the personal characteristics such as age and gender, social characteristics such as marital status, and professional characteristics such as professional group and specialities. The different perspective comes when dual practice physician is seen as labour supply. Hence the physician's characteristics give important effect to it. Empirical analysis by Johannessen and Hagen (2014) and Johannessen and Hagen (2012) show the significant effect of gender on dual practice. The motivation of involving in dual practice activity may be quite diverse at the individual level. Study should consider that physicians have different expectation and career goals. The physician's characteristics such as age, gender, marital status and number of children are important physician's characteristics that determining dual practice (Askildsen & Holmas, 2013). Dual practice decisions among physicians are also vary according to urban or rural residence. Previous researches using Portuguese case studies mention that the differentiation on rural-urban location is important for the extent for dual practice (Ferrinho, et al., 2003) and (Antunes, et al., 2002).

Physician decision for engaging in dual practice is closely related with the workloads and attractiveness of the facility (Johannessen & Hagen, 2014). Their study objectives are also motivated with the hospital reform that changes the structures of hospital in term of number and functions. Askildsen and Holmas (2013) mention it as work characteristics. Their research assumed that physician's choice of working hours between main job and additional job follows utility maximization. The jobs characteristic matter when the physician wants to allocate his time in order to gain optimal result of wage increase. For example when hospital has too many occupied beds so that physicians have very high workload during the work day. Physician will have additional workload. The marginal effect of additional work is negative. The effect of wage increase on working hours because of this additional working load will be diminished compare to the situation before the increasing of physician's workload.

From the previous literature we construct our testable hypothesis on physician's decision on dual practice by analysing physician's choice of working place in public sector only, private only, and dual practice. 1. Income, as appeared in previous researches, positively affects the physician decision of working place. It means that physicians look for the highest income level. 2.Our research considers that physician's decision also related with the physician's residence based on rural-urban residence and Java Island and Non-Java Island residence. We include the urban and rural specification as it represents the working condition for physician where urban area usually offers more convenience. This applies for Java and Non-Java specification. For the Indonesia case, Urban and Java is more populated area compare to rural and Non Java area. We expect that physician in rural and Non-Java area will choose to work as dual practice physician. 3.The individual characters such as years of experience, gender, education, and ability of local language are important as determinant of physician's decision. Physician with more years of experience is expected to work in non-dual practice sector. Female physician is expected to engage in public sector. Physician graduated from leading medical school is expected to work in private sector. Physician ability in speaking local language reflects physician's qualification to communicate with patient. Physician who mastered the local language is expected to work as dual practitioner. 4.The percentage of elderly population and physician's ratio will negatively affect the physician's decision on dual practice.

4.3 Physician Dual Practice: Context and Data

This section gives information about the dual physician practice in Indonesian context and data that we use in this research. The sub chapter provides information on how physician usually decides on being a dual practice physician, the regulation, and monitoring system from health authority.

4.3.1 Dual physician practice in Indonesia

Indonesia is the biggest archipelago country with around 17 thousands islands and total area of 7.81 Million Kilometres squared consists of 2.01 Million km^2 main land, 3.25 Million km^2 oceans, and 2.55 Million km^2 of Exclusive Economic Zone (EEZ). The geographical conditions are potential sources for country's development but create obstacles as well. One of the potential resources comes from the human resource with the total population is estimated around 255 Million in 2015, and 60% of them is in productive age between 15 to 64 years that provides work force supply. One of the difficulties is the unevenly population distribution. Among 17 thousands islands only around 12% of them is inhabitant while there is still 88% of uninhabited island. Almost 60% of total population is concentrated in Java Island. Based on the administration division, Indonesia consists of 34 provinces since 2015, and Java is divided into 6 provinces. Therefore Java Island is usually identified as a centre of economic activities and it has more rapid infrastructure development compare to the other islands.

Health care services are provided in public and private health care facilities. The public health care facilities use referral system that starts from public community health centre and community health sub-centre that available in sub district and village level. There is no referral system in private facility and patients can visit any private facility such as private clinics, physician practice, or private hospital. The community health centre primarily provides outpatient care although about two third of them also provides inpatient care. The health personnel structure in public facility usually consists of general physicians, midwives, nurse and supporting staffs like dentist, nutritionist, and pharmacist. The average ratio of public community health centre per province level is one community health centre per 300,000 populations. Some provinces in Indonesia have lower ratio due to the densely populated such as provinces in Java while province with low population density such as West Papua has 5 community health centres per 300,000 populations. The secondary care is provided in public hospital level in the public referral system and private hospitals. The public hospital is completed with the service of advanced cases and inpatient treatments. There are 2,488 total hospitals in Indonesia with around 309 thousands total beds where 64% of them is public hospital, and consist of general hospital and specialized hospital. The bed ratio for the general hospital is in average one bed per 1,000 populations.

Physician is the main component of health care personnel who can deliver the health care services. However, health care delivery in Indonesia still relies on non-physician health care personnel such as midwives. The available regulation still allows midwives to provide health care services particularly maternal and children health care services. Midwife has the largest percentage on the public community health centre component around 31% from total human resources in the facility while physicians have the 9% from total human resources in community health centre. Based on Indonesian Medical Council in 2015, the registered general physician in total is 109,597 from total 168,832 of general physicians, dentist and specialized physicians. The detailed number is available in the Figure 4A.6 of Appendix 4A.

Dual practice formerly existed to fulfil the demand of public health care in limited resources. Number of physicians in Indonesia is 95,976 doctors who serve around 243.6

million populations in 2014. A physician serves around 2,538 residents. This figure is slightly higher compare to WHO recommendation that a physician should serve 2,500 residents. The ratio also relatively high compares to Indonesia's neighbouring countries such as Malaysia, with one physician for 835 populations, and Singapore, where one physician serves 513 people. Similarly, other calculations show that, on average in 2013 the number of medical doctors per 100,000 people was 37.2. This later figure represents the average physician ratio per 100,000 populations in 33 provinces in Indonesia, with the respective minimum and maximum values of 8.9 and 151.5 physicians per 100,000 individuals, by province. This achievement is relatively remarkable compared to the 15.7 physicians per 100,000 people in 1996. Based on "Indonesia Sehat" program indicator, which is a government's program to increase health quality in Indonesia, the physician ratio should be 45 per 100.000 people, in a national scope; Indonesia has not yet reached the target as only eight provinces have already achieved the goal. Looking further in detail, the ratio per area shows the difference gap between the minimum and the maximum is still significant (Ministry of Health, 2015). This indicates the unevenly distribution of physician in Indonesia.

Community health centre located in sub-district area is the main point of services for the population to get primary care. However, some of the community health centres available still have unideal proportion in term of health personnel. Around 26% from total public community health centre is still lack of general physicians while almost 47% is lack of dentist. Most of the community health centres with lack of physicians are located in the eastern part of Indonesia, for example: in Papua province 66% of its community health centres is lack of physicians, 60% in Maluku province, and 51% of community health care centre in Nusa Tenggara Barat is lacking of general physicians. This is contrast with provinces in Java Island that in average only has around 18% of the facility that still lacks of general physicians.

Indonesia Ministry of Health also has particular program by recruiting physician to work as temporary public physicians in order to fill the physician position in public community health centre. The contract usually last between 2-3 years based on the area category that can be differentiated as, normal, remote or very remote. The last category offers the shortest working contract and has the highest salary rate and higher opportunity to be permanent public physician. Based on the active temporary general physicians, most of them, or about 57% is placed in the very remote areas in all of Indonesian. The 39% is placed in the remote areas and only 4% in the normal area. Most of the placement is on the provinces outside Java Island.

The existing regulation on dual practice in Indonesia controls public physicians working in private practice outside the public office hours. The newest adjustment of dual practice regulation is by putting the maximum number of medical practice for each physician into only three practices. Suppose public physician works in the public community health centre during work day from Monday to Friday from 8 AM to 5 PM. This public physician might also work as dual practice physician by opening private practice from Monday to Wednesday at 6 PM to 8 PM   and working in different private clinics from Thursday to Friday at 6 PM to 8 PM. This particular physician is said to meet the maximum number of practice and cannot have another practices anymore. From health care authority perspective, this limitation relates to quality control and monitoring for physicians, although in fact there is no meaningful punishment for a violation of the working hours or number of practices. A warning letter is a punishment for common cases but usually not followed by more severe punishment.

Dual practice physician is a career choice commonly for the public physician to open private practice after public working hours. The general career path for the physician in Indonesia and the dual practice decision can be described in the Appendix 4D. The physicians finish the education including clinical competency, then take the medical oath and get the competency certificate. The physicians then continue to work in internship program by working in public or private health care facility to perform clinical competency under senior physician supervision. The internship program is usually taken in two years and at the end of the internship program, the physicians get the registration letter from the medical council. The registration letter is valid for five years and can be renewed after. The letter indicates that the physician has already completed the academic and internship education and ready to start working in public or private path.

The usual career starting for the fresh graduate physician is taking the public sector path by applying as a permanent civil servant or temporary public employee in public community health centre. The first option is a highly competitive job where the number of works offered is based on civil servant formation needed in the Ministry or in the regional level. The competition occurs because the positions are limited while the applicants are abundant. Besides civil service option, there is a temporary public employee which is a particular program to support health care provision in the areas that categorized as remote based on the Ministry of Health criteria. These areas are usually rural areas, in remote islands or mainland with difficult access and geographical barriers. The contract duration varies from 2-3 years, two years if the placement areas are categorized as very remote and 3 years if categorized as remote. After being accepted as civil servant or temporary public employee, the physicians will apply for the practice permit particularly for those with assigned job descriptions in medical practice. But for the ones who get the non-practice duties, they are unnecessarily taking the permit. Some jobs in civil servant formation might not have job description on medical practice but all temporary public employees will be assigned with medical practice job description. Each practice permit is valid for one practice and based on the regulation, each physician can only registered maximum in three practice permits. The change between non-medical practice and medical practice is quite easy. When they want to move into medical practice job they just need to apply for the practice permit at any point of time. After having the permit, the dual practice decision then takes place. These public physicians (civil servants and temporary employees) are opening the private practice or working in private clinics after public working hours. The public sector path although in highly competition environment but usually attracts the fresh graduate physicians to start their medical career. The temporary contract option although for short time period and placement area is in the difficult area but this job is offered with competitive salary level compare to the permanent civil servant.

The other career option for physicians is taking the private sector by directly applying for the practice permit from the public health office in district area level. The permit is mandatory for a physician who wants to provide health care services in this case is working in private facility such as private clinics or private hospital or establish his own private practice. The change into dual practice physician is when private physicians working in public facilities, in practice or non-practice jobs in the same time periods when they also still working in private facilities. Some physicians are taking the private path in the beginning because they decide to work as private physicians. Some other is taking the private path while waiting the opportunities to work as permanent civil servant or temporary public physicians.

Due to the dual practice identification using IFLS wave 5, public community health centre and private facility questionnaire, our research narrowed into two types of dual practice physicians. The first one is a public sector physician who has a private practice after public working hours. The public sector physician is not necessarily a permanent public physician or usually called a civil servant physician but he also could be a temporary public physician who works in public facility for a specified period based on the contract. The second type of dual practice physician is identified using private facility questionnaire. Dual practice physician is a physician who provides service in private health care facility, this means that he works in private sector but also identified as having job in public facility, and therefore he works in private sector and public sector. The public facilities are not necessarily a public health care facility but could be an educational jobs or government owns administration such as university or health office. The work status in public facility is not limited as a civil officer but in general as temporary workers are also included. From this type of identification, we can sure that the private side part is medical activity related but we cannot distinguish the other part of the job whether it is medical activity related or not.

The physicians particularly those whom are prefer to work in practice job first recorded in the medical council through the registration letter application. Then the public health office in district level will register the physicians and the place where they practice. The public physician performance and dual practice activity will be monitored by Ministry of Health. The private physicians are monitored only when they apply for the practice permit in the public health office. Annual data from each district public health office will be sent to the Ministry of Health. From this report, the general information in each province can be monitored. However this report does not contain the dual practice physician information. The decentralization policy in Indonesia since 1999 causes each public health offices manage their own physicians. Most of public health office issues the practice permit and stores the information manually. So that the dual practice physician's activity is somehow not being monitored in higher level. This is also the main reason why our research utilizes the survey data of IFLS wave 5 and the explanation is available in the next sub chapter.

4.3.2 Data

We use the Indonesian Family Life Survey (IFLS) 5, which was fielded in the late 2014 and early 2015. The IFLS is a longitudinal survey and the first IFLS in 1993 was held initially in 13 provinces of 33 provinces in Indonesia. The most recent of IFLS survey is IFLS wave 5 that covers 23 provinces out of 33 provinces in Indonesia. The selected provinces represent all provinces from the western to the eastern of Indonesia with some excluded provinces because of the expensive interview cost due to the access difficulties and security issue. The provinces excluded from IFLS wave 5 come from three main islands in Indonesia: Sumatra (Nanggroe Aceh Darussalam, Riau, Jambi, Bengkulu), Kalimantan (west, central, east), and Sulawesi (north, central, southeast). The survey is conducted by RAND and Survey Meter. It is based on sample of larger scale survey by Indonesian National Statistics Office, the social economics survey (SUSENAS). We use the IFLS data because this survey provides us the complete information particularly dual practice physician identification that we cannot find in other data sources.

Our research extracts the particular information of physician from IFLS facility questionnaire. One of main challenges in this research is on the sample selection that will be discussed in detail in the sub chapter of sample selection. The purpose of the IFLS survey is to collect the information on the households and community facilities, which are village administration, schools, and health facilities. The information on physician for our purpose is collected using the facility information as an approximation, by using the information available in the health facility questionnaire. The physician sample representation hence follows the health facility location and the inclusion criterion is more to the completeness of the physician information. We can get physicians detailed information as long as their work places are included as IFLS wave 5 community sample. Regarding data collection, the obstacle also comes from the missing values on physician information especially from the private facilities. The interviewing process in the private facility sometimes only include the front office staff, nurse or other non-physician component, hence the information of physician will be lost. The public facility interview more successfully captured the physician information as most of the interviews involved the physicians.

To match the physician data with potential demand factors such as doctor ratio, we merge the physician data from IFLS wave 5 with Indonesia Potential Village Survey (PODES) year 2014 based on the area code. This PODES data provides basic information from the smallest administration area level which is village level and we get the data of the number of health worker, and health facilities. The matching process with IFLS wave 5 data uses a sub-district which is an administrative level consists of several villages. The number of the population comes from Census Population (SP) 2010.

Thus, the final dataset used in this chapter results from merging the data from different surveys and databases.

4.4 Empirical Strategy and Estimator

The empirical strategy in this research is designed to answer the research question on the factors that affect the physician decision to engage in dual practice. Our hypothesis is that income motivation is the main factor influencing physicians on decision to do dual practice. The rising income from single income source might reduce the physician willingness on being dual practice. The physician's residence such as rural urban and island specification have important influence to the physician's decision. The physicians from rural and outside Java Island will have higher probability of engaging in dual practice. Beside the income and physician's residence, there are two groups of factors that affect the physician's decision, the potential demand factor that consists of population size and the need of population and individual physician factor such as years of experience, gender, and education. Physicians consider the competition among them when deciding on being dual practice. If the area still has low number of physicians compared to population, a physician might have higher chance on being dual practice to fill in the market. The decision also reflects the need of health care and workloads. In the region where it is indicated the high need of health care, the dual practice occurrence might be higher compare to the area with lower rate of health care need. Dual practice decision also related with the individual physician characteristics such as education, language ability, gender, and experience. The dual job might be more attractive for male physician rather than female physician. Dual practice might be a good option for the less experience physicians, as they will need benefits offered in public sector and additional income from private sector in the beginning of their career. There are two models in the research to explain how physician decide on dual practice job based on the assumptions for each model which suit to the available data.

4.4.1 Main Model

It is important to have clear definition of physician dual practice before we construct the empirical strategy because it indicates in the introduction that dual practice can be defined in many ways. In general, a physician has to deal with several choices of working place, from a primary care provider such as public community health centre or private practice to secondary care such as public or private hospital. Physician basically can choose to work in one place only or engage in several places in the same period. For example, physician decides to work in public hospital only. While in other case physician decides to work in public hospital in the morning and open private practice in the afternoon. The latter case is the example of dual practice. The kind of job can be related with the medical practice or administrative work. We simplified the choices into three aggregate categories based on the sector of public, private, and dual practice. In our model, the dual practice includes the physician work in primary care and secondary care. The kind of works is not only related with the medical practice but might be administrative too. Our model describes dual practice as a dual job by physicians based on sector. As long as they work in two or more places and those places can be identified as public sector and private sector, these physicians are categorized as dual practice. The facility sector is based on facility ownership. A public facility is owned by the government while the private facility is run by an individual or private company. A public community health centre, public hospital, administration office, military, university, and public company are categorized as public. Private clinics, private practice, private company and other unspecified working place are a private facility. Dual practice is a category when physician works in both types of facility.

In our main framework, income variable can be treated as an alternative specific regressor by assuming that physician has the income information from all alternatives before he made his decision. Each physician will have sets of income for each sector, dual practice sector, public sector, and private sector. The income per sector will reflects the potential income if physician would join in the chosen sector. We face the problem because the survey only captures the observed income from the chosen alternative. For example, we have a private physician in the sample. The income information available is income from his private sector, while information on remaining alternatives: public sector and dual practice are not available. We estimate the unobservable income using estimation process explained in Sub chapter 4.5.2. The income variable uses as alternative specific in the physician decision of working place between public, private, and dual practice. Using this information, physician's choice of working sector will depend on alternative specific which is income per sectors and several characteristics specifics such as experience, gender, education, local language ability, geographical identification, percentage of elder population, and physician's ratio.

We want to analyse the physician choice of working sector among a set of alternatives. We have physician as unit analysis and uses physician characteristics as explanatory variables. The model also contains a set of alternative for each physician and the explanatory variable is this alternatives. The conditional logit focuses when we want to model the choice of the alternatives as a function of the characteristics of alternatives (Hoffman and Duncan, 1988). Our case fits the alternative specific conditional logit which is the specific case of the more general conditional logistic regression model (McFadden, 1974) which allows the explanatory variables consist of alternatives characteristics and case characteristics. Following the explanation in (Greene, 2012), physician's choice of working sector is unordered choice generated from the random utility model. For the i th physician deals with J choices, the utility choice of j is[1]:

$$U_{ij} = z'_{ij}\theta + \varepsilon_{ij} \qquad \textbf{(4. 1)}$$

If the physician makes choice j then we assume that U_{ij} is the highest utility among all J utilities. The probability of physician takes choice of j is

[1] These presentation follows Greene(2009) and Cameron and Trivedi(2009) with the adequate change to fit in our content.

$$Prob(U_{ij} > U_{ik})\ for\ all\ other\ k \neq j \quad \textbf{(4. 2)}$$

The model is made by considering particular choice for the disturbances. As unordered discrete choice case, we consider to use logit model. It has been widely used in many fields, including economics, market study, politics, and finance and the same time it offers simpler interpretation compare to the other model that is often used, Probit model. Suppose Y_i is a random variable that indicates the choice of working sector by physician. The J disturbances are independent and identically distributes with Gumbel (type extreme value 1) distribution,

$$f(\varepsilon_{ij}) = exp\left(-exp(\varepsilon_{ij})\right) \quad \textbf{(4. 3)}$$

Then the probability is,

$$Prob(Y_i = j) = \frac{exp(\boldsymbol{z}'_{ij}\theta)}{\sum_{j=1}^{J} exp(\boldsymbol{z}'_{ij}\theta)} \quad \textbf{(4. 4)}$$

(McFadden, 1978).

The utility depend on $\boldsymbol{z}_{ij}$that consist of aspects specific to the individual and the choices. The $\boldsymbol{z}_{ij} = [\boldsymbol{x}_{ij}, \boldsymbol{w}_i]$ and $\theta = [\beta', \alpha']$. The $\boldsymbol{x}_{ij}$ is known as attributes of choice and it is varies across the choice of working sector by physician. The $\boldsymbol{w}_i$contains the character of physician and therefore the same for all choices. The model in 4.4 then becomes,

$$Prob(Y_i = j) = \frac{exp(\boldsymbol{x}'_{ij}\boldsymbol{\beta} + \boldsymbol{w}'_i\boldsymbol{\alpha})}{\sum_{i=1}^{m} exp(\boldsymbol{x}'_{ij}\boldsymbol{\beta} + \boldsymbol{w}'_i\boldsymbol{\alpha})}, = \frac{exp(\boldsymbol{x}'_{ij}\boldsymbol{\beta})exp(\boldsymbol{w}'_i\boldsymbol{\alpha})}{[\sum_{i=1}^{m} exp(\boldsymbol{x}'_{ij}\boldsymbol{\beta})]exp(\boldsymbol{w}'_i\boldsymbol{\alpha})} \quad \textbf{(4. 5)}$$

The case specific regressors which are variables that are related with physician characteristics in this research are whether the physician is a male physician, graduated from well-known university, speak the local language, live in urban area, located in Java Island, years of experience, the number of population in the area of physician's residency, and physician ratio in the area of residency. The alternative regressor is a variable that relates with dependent variable or in this case is income of working sector that relates with a choice of physician.

4.4.2 Alternative Model

We provide the alternative model to provide comparison analysis on factors that effects physician decision on working sector. The multinomial logistic regression works for characteristics specific regressors. The model represents the individual choice that is affected by the individual characteristics and not from the alternative characteristics. In our main model, we have income variable per sector that represent the alternative characteristics of working choice. In this model, we assume that income is a physician characteristic that varies for each physician, and will be the same for all alternatives. We use income of main job which is an observable variable taken from questionnaire. Income variable together with the other general physician characteristics such as physician's residence (urban-rural identification and island location), individual characteristics (gender, education, local language, experience), and potential demand (population per area, and physician ratio per area) will characterized the physician's choice of working sector between dual practice, public, or private sector. The model of physician's choice in multinomial logit is

$$Prob(Y_i = j|\boldsymbol{w}_i) = \frac{exp(\boldsymbol{w'}_i\boldsymbol{\alpha}_j)}{\sum_{j=0}^{2} exp(\boldsymbol{w'}_i\boldsymbol{\alpha}_j)}, j = 0,1,2. \quad \textbf{(4. 6)}$$

The estimated equations provide a set of probabilities for the $J + 1$ choices of physician's working sector with physician's characteristics of $\boldsymbol{w}_i$. We eliminate the indeterminacy in the model. Suppose we have $\boldsymbol{\alpha}_j{}^* = \boldsymbol{\alpha}_j + \boldsymbol{q}$ for any vector $\boldsymbol{q}$. The calculation in 4.6 using $\boldsymbol{\alpha}_j{}^*$ instead of $\boldsymbol{\alpha}_j$ will generate the identical set of probabilities because all the term involving **q** is drop out. To solve the problem and because the sum of probability equals to one, we use $\boldsymbol{\alpha}_0 = 0$. Only J parameters are needed to get the J+1 probabilities. The probabilities are

$$Prob(Y_i = j|\boldsymbol{w}_i) = P_{ij} = \frac{exp(\boldsymbol{w'}_i\boldsymbol{\alpha}_j)}{1 + \sum_{k=1}^{J} exp(\boldsymbol{w'}_i\boldsymbol{\alpha}_k)}, j = 0,1,..J. \quad \textbf{(4. 7)}$$

The model allows us computing the log-odds ratios:

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = \boldsymbol{w'}_i(\alpha_j - \alpha_k) = \boldsymbol{w'}_i\alpha_j \ if \ k = 0 \quad \textbf{(4. 8)}$$

The odds ratio, P_j/P_k is independent from remaining choices. This property is called the independence from irrelevant alternative (IIA). The IIA property is convenient from the estimation point of view but, it is not very practical in real decision making process. Multinomial logit model requires IIA property checking in order to have valid result. Hausman and McFadden (1984) proposed by omitting the subset of the choice set from the model altogether, if the parameter estimation does not changes systematically, then the choice set is irrelevant. The exclusion will be inefficient but will not lead to inconsistency, while letting the choices when the odd ratios is not independent will lead to inconsistency. If IIA holds, the statistics for the Hausman's specification test is:

$$\chi^2 = (\widehat{\alpha_s} - \widehat{\alpha_f})'[\widehat{V_s} - \widehat{V_f}]^{-1}(\widehat{\alpha_s} - \widehat{\alpha_f}) \quad \textbf{(4. 9)}$$

Where s is the estimator based on the restricted subset, f is the estimator based on the full set of choices. The $\widehat{V_s}, \widehat{V_f}$ are the respective estimates of the asymptotic covariance matrices. The χ^2 is Chi-square distribution with degree of freedom equals to number of row in $\widehat{\alpha_s}$.

4.5 Variables

The definitions for dependent variable and independent variables are as follows. The dependent variable is physician choice of working environment and categorized into three choices: private physician, public physician, or dual practice physician.

Private physician.

A physician is categorized as private physician if the physician only works in non-government owned health care facilities. This refers to a facility that run by private individual or private company such as private practice and private clinics. The private facility questionnaire of IFLS covers the private practice and private clinics. Using the identification of IFLS wave 5 questionnaire, a physician is categorized a private physician if he does not have any other practice beside his private clinics or private clinics.

Physician might have another jobs but it must been indicated in private sector whether it is related with medical practice or administrative.

Public physician.

A physician is categorized as a public physician if physician only works in the public facility, a government owned health care facility. The IFLS community facility only covers the public community health centre and excludes the public hospital. The physician works in public facility usually also a civil servant or permanent worker but in this research we include the non-civil servant physician or temporary contract physician as long as the physician only works in public facility. We identify public physician using public community health centre questionnaire that listed all physicians available in the facility. But only one physician for each facility is included in our sample because the detailed physician information will be asked only to one physician per facility. Based on the IFLS questionnaire public community centre questionnaire, a public physician is a physician working in public community health centre only and not having any private practice.

Dual practice.

The general term of dual practitioner is a physician who works both in public facility and also in the private sector. The identification process can be seen in the graphic of Appendix 4A, Figure 4A.5 on how dual practice identification process to guarantee a valid identification. There are two different ways to classify physician being dual practice based on the availability data of IFLS wave 5. From the public community health centre sample, a dual practitioner from this sample group is a public physician who has a private practice. We indicate physician as dual practice physician if the answer from a question "does the head of public community health centre have a private practice?" is yes. The structure ignores the possibility that physician may not have a private practice, but he might work in other private facilities. From private facility sample, we classify physician as a dual practitioner if a physician has primary jobs in one of the following places: public community health centre, a government hospital, office/health administration, a military agency, a government-owned company, another public department, and university. The dual practice identification from the questionnaire comes from the question item of "Where is your primary place of work?" If the physician has primary work on the public facility, hence he will be identified as dual practice physician. We also match the question to validate the information of dual practice on the question of "Which category best describes the work you did in the primary job?" The answer of the question should be other than "government worker" to indicate a dual practice physician. Those questions are available in IFLS wave 5 community facility questionnaire and will be answered by physicians during the interview process.

The independent variables are:

Education

This variable represents the quality of the physician from his educational background. We use the educational background to identify the physician ability although it quality aspect should be composed from many aspect but this is the only instrument in the IFLS questionnaire that fit our purpose. We code one if physician graduates from top five medical schools in Indonesia: University of Indonesia, Gadjah Mada University, Airlangga University, Padjajaran University, and Diponegoro University. The description using QS world university ranking places the University of Indonesia in rank of 277, the highest among of them. While Gadjah Mada University has 401-410 ranking, Airlangga University is in 701-750, Diponegoro University is in 801-1000, and Padjajaran University is number 201-250 in Asian University Ranking. We code 0 if physician graduates from others universities.

Male

This variable indicates male physician as coded 1 and female as 0.

Language

Variable of the local language is a coded 1 if the physician can speak the local language and 0 if the physician does not speak the local language. The ability to master local language is one of quality measurement to maintain communication ability between physician and patient. Indonesia has many local languages, and although there is the national language, most people usually speak local language especially in rural areas.

Java

The variable is coded 1 if physician lives in Java Island and 0 otherwise.

Urban

This is a binary variable to identify whether physician lives in urban areas (1) or zero otherwise.

Experience

Variable of experience measures number of year's physician has graduated from medical school. The experience year is the subtraction between the year of the survey, 2014 with the graduation year of the physician. The approach neglect the possibility that physician might not directly involving in medical practice. The IFLS questionnaire provides information on which year physician working in the facility. It would be a good indicator if the physician work in the same place since the beginning of the career but the question applies only on the facility being interviewed and cannot track the physician working history before. Hence we avoid this information. Another attempt to measure experience is from the physician's age but the age information is only available for the private facility questionnaire and not for the public facility questionnaire.

Population

We have full set of population data in general. But in the final model, we use the elderly population. This is the percentage of population aged 65 years and above in the region. Data is from Indonesia Population Survey 2010. We also consider several indicators to represent health care demand in the area such as: percentage of population age 5 years and bellow, percentage of population aged 1 year, and population of productive age between 14 years to 65 years old. The final indicator that provides satisfacotry result is the percentage of population aged 65 years and above.

Physician ratio

This variable together with the variable of population describe potential demand and workloads of physician. The physician ratio also shows the physician supply for each sub-district compare to the population whom potentially needs health care treatment. Physician ratio is the number of people divided by the number of physicians. We get the information for the number of physicians from Village Potential Survey (PODES) in 2014. Total physician in a sub-district based on the definition in the survey is some physicians who reside in the area. This definition has the consequence that a sub-district might have low number of physician although health facilities exist in the area, this is again due to the definition of physician reside in the sub-district and not based on facility records.

Main income

Variable of main income is per month income in Indonesian Rupiah from physician's primary work. This is included as physician's characteristics in the alternative model. There are two different approaches to get this information and this is described in Figure 4A.2 of Appendix 4A. The first approach is using main income to represent physician's income from working sector based on physician's declaration. From the private sample (physician being interviewed using private facility questionnaire), physician will determine his primary job and mentions the total income from it," What is the approximate total income of the primary job per month?" If physician only has one job, the income from this job is categorized as primary work. For physicians who have several jobs, the primary work is based on physician's declaration on which job he will categorize as primary job without referring to the highest wage or the longest working hours. From the public sample (physician being interviewed using public facility questionnaire), main income comes from a question of "What is the revenue per month earned from employment as Head of Community health Centre"? Here we assume primary job for public physician sample is as Head of public Community Health Centre and usually associated with the public salary regardless the physician status as civil servant or non-civil servant (temporary contract physician). This variable failed to separate income based on sector, public sector, private, or dual practice. The main income represent physician's income from a job that he categorized as primary job, whether it is based on the most working hours spent in the kind of job or the highest income if physician works in more than one job. The purpose of using the main income variable is to measure income motive from one job that classified as primary job regardless its sector. To accommodate the income based on the sector, the next variables explanation will reveal our attempt of second approach to get more accurate information on the income based on physician's working sector.

Private income

Variable of physician income of private sector is the income that comes from private clinics, private practice, private company and unspecified categories working place. The private income variable indicates total income of the physician from private sector only and to be differentiated from the main income variable. The sources can be a regular monthly income from private clinics or treatment fee charged from the patients, but all will be calculated to be a monthly income in Indonesian Rupiah (IDR). The extraction process using questionnaire appears in Figure 4A.4 of Appendix 4A. The private income information comes from physician who interviewed using IFLS private facility questionnaire, after physician is being identified as a private physician or dual practitioner. The questionnaire is used to identify the private income from private physician and private income from physician that is indicated as dual practice physician.

Ideally data also provides the private income for public physician if the physician is working in private sector. This kind of data will be useful to estimate our alternative model. Unfortunately such data is rarely available in the survey. We estimate the private income for the public job position holder using regression process that is provided in Sub chapter 4.5.2. The estimation process follows the general idea that public physician will have similar private income if he shares the same characteristics with the private physician. Some of the characteristics are gender, physician's experience, Java island identification, and income from primary work conditional that physician is working in private sector.

Public income

The public income is the total income of physician from working in public sector. The variable indicates the monthly public salary and the measurement unit is Indonesian Rupiah. The public salary comes from public facility questionnaire; see Figure 4A.3 of Appendix 4A. The information available in the questionnaire that is related with public income is straightforward and can be used for our purpose. The estimation process of public income is applied for the private physician because we do not have any data for private physician if he works in the public sector. We assume that the similar private physician characteristics with public physician characteristics will share the similar level of public salary. These characteristics are physician's experience, urban-rural identification, Java island identification, and number of working hours dedicated to serve patients. The complete steps obtaining the estimation public salary for private physicians if he works as public physicians are available in the Appendix 4C.

Dual practice income

The dual practice income is the total income for physicians who are working as dual practice physicians. In the public facility questionnaire, the dual practice income is the summation of public salary and income from private practice. Of course we have to identify first whether physicians are dual practice or public physician. The estimation process is applied to get dual practice income for public physician as if he works as dual practitioner. In the private facility questionnaire, if physician is identified as dual practice physician, the dual practice income is the total income between income from private facility being interviewed and income from the main job that categorized as public. If the physician is identified as private physician then the total income from data available refers to private income. It is the summation of income from private practice and income from the main job that also categorized as a private sector. To get the dual practice income information from private physician, the estimation process is needed as available in Sub chapter 4.5.2.

4.5.1 Building the sample

Selecting sample for this research from IFLS wave 5 data is a challenge because the available information is designed to focus more on the health care facility and not particularly on dual practice physician activities. The sample selection for this research is by considering the completeness of the information of the physician. The detailed process of sample selection can be described in the graphic of Appendix 4A, Figure 4A.1. The physicians come from two kinds of questionnaire based on the health care facility questionnaire of IFLS, the public health community centre and private practice questionnaires. There is 961 public community health centre, and 3,529 private clinics and private practices. The rate of non-response for the private facility is high, about 54.75%, therefore the valid facility in the private facility sample is only 1,597 facilities. Ideally, from each facility that are willing to participate in the survey, one physician will be interviewed to answer the general questions on the facility and specific question on physician including the technical questionnaire on treatment management. In most of the interview process, the survey officer cannot interview the physicians and only meet the facility representative hence the facility questionnaire can be filled but the specific part of questionnaire on physician will be left missing. More than half of the public facility can be presenting physicians during interview so that we have sample of 540 physicians from the dual practice identification using public community health centre questionnaire. The private facility in contrast, most of them cannot involve physician during interview. The low number of the physician is caused by low chance of physician being interviewed because most of them are unable or unwilling to do the interview and most of the facility interviews are answered by nurse or midwives. There are 380 physicians from private facility that can provide the physician's information for our purpose. The complete pooled physician information from facility sample is 920 physicians from both facilities questionnaire. The physicians mostly have complete information on the physician characteristics such as physician choice, male or female, education and geographical identification. The sample then reduce to 721 when entered the first regression model due to missing values mostly come from the main income variable.

Physician in public facility is classified as a dual practitioner if a physician has a private practice. We neglected the fact that dual practice physician can work in any private facility and it does not have to be having his private practice. The questionnaire cannot track further information such as physician working in another private facility. Physician in private facility is recognized as a dual practitioner if he has a primary job in public facilities such as public hospital, public community health centre, public health office, military hospital, a public company, public department, and public university. The other question to control the validity dual practice classification is an occupation in primary job whether the physician is categorized as a civil servant.

4.5.2 The estimation process of alternative incomes

Physician's information on income from IFLS data is only available when physician is working in one particular sector whether it is public, private, or dual practice sector. Our main model assumes that income per sector is the alternative specific variable therefore we need the information of income for all sectors for each physician even when the physician only related with one particular sector. Suppose a physician is a public physician, the information that we have is income of public sector, while the income of private sector assumed that the physician is working in private sector and income of dual practice as if physician working in dual practice sector are not available.

The first attempt of estimation process, we will refer to this as Model 1 to get the alternative incomes assumed that physicians will share equal characteristics that determined the income level for each sector. The estimation is linear regression model

$$y_i = x_{i1}\beta_1 + x_{i1}\beta_1 + \cdots + x_{iK}\beta_K + \varepsilon_i, i = 1, .., n \qquad \textbf{(4. 10)}$$

Where y is income of physician, x is the explanatory variable that affects physician's income, and the random part of ε_i. In the first attempt, we differentiate the estimation process based on the origin of income information, whether physician is interviewed in public facility (public facility questionnaire) or private facility (private facility questionnaire). This differentiation is needed because we concern on different information captured between those two data sources.

The estimation process of alternative income if physician working in private sector

The estimation process uses the data from private practice facility questionnaire by considering the same information available in the public facility questionnaire. The total income from private facility comes from the questionnaire item of A21B, "What is your overall montly income from all practices you have?". We double check the amount in A21B with A5B, "What is your estimated monthly income from working in this place?". The question of A5B refers to the income from the visited private facility during interview of the survey. The amount of monthly income between A5B and A21B should be the same if the physician is a private physician and only work in one private practice. The monthly income of A21B should be larger than A5B if physicians work in more than one health care facility. Although most of the physcians work in one place, but there is about 20 percent of them who work in more than one practice place. The next identification is by classifying whether the physician also a dual practitioner so that the total income should be separated from the public sector, and we include only the income from private sector into estimation process. In this case, data transformation into log value is need to get a better prediction. See Table 4C.2 of Appendix 4C for the complete output.

$$\ln(incpv) = 6.704246 + 0.1576236 Male - 0.0078889 Experience + 0.6148936 \ln(Mainincome) - 0.2276822 Java \tag{4. 11}$$

The variables determine the amount of total income from private sector are: gender, experience, main income, and Java Island identification. The last two variables more likely measure the physician ability in gaining more revenue in private sector. The main income is the income from physician' main job, whether it is public or private sector based on physician convession. We then apply the estimation equation to data from public facility questionnaire, which are public physician or dual practice, assume that they are working as private physician.

The estimation process of alternative income if physician working in public sector

We use data from public community health centre questionnaire which has a specific question on public salary. It captures monthly income for physician working in public community heatlh centre. The working status is unable to differentiate between the permanent government worker or temporary contract physician hence we do not distinguish physician based on permanent or temporary contract. The sample from public facility data is 540 physicians, and the missing values for this variable is about 13 percent and being imputated using the average salary based on the administration level: region and province. It is assumed that salary might be equal among physicians in the same administration area. We regress the salary to variables that related with salary level: experience, urban, Java, and number of working hours dedicated to serve patients. Those variables are the variables that most affected the public salary level among physicians. See Table 4C.1 of Appendix 4C for the complete output.

$$\text{salary} = 1{,}056{,}474 + 156{,}616.4\, Experience - 1{,}266{,}074\, Urban + 1{,}078{,}308\, Java + 60{,}142.31\, Working\ hours \tag{4. 12}$$

The next step is applying the estimation equation to the data from private facility questionnaire to get the estimate public salary assume that they are working as public physician. The estimation process in private facility data involves 380 physcians.

The estimation process of alternative income if physician working in dual practice

Physicians from public facility sample can be identified into two category: public physician and dual practice physician. The dual practice income consist of monthly public salary in Book Puskesmas question A5A, “Approximately, what is the amount of revenue per month you received as the head of Puskesmas ?” and income of private practice from Book Puskesmas question A10A, “Approximately, what is the amount of revenue per month you received from all the private practises” ? The public physicians will have the answer on question of A5A but zero on A10 A, while dual practice physicians will have both questions filled in. The estimation process is needed to get dual practice income for public physician assumed that he works as dual practitioner. The estimation starts by regressing the total income of dual practice using the available information from public sample. The regression equation gets, see Table 4C.3 of Appendix 4C for the complete output.:

$$\begin{aligned} Dual\ practice \\ &= 138751.6 Experience + 1392283 Urban \\ &+ 0.9651807 income\ from\ private\ practice + 3517709 \end{aligned} \quad \textbf{(4. 13)}$$

The estimate value is filled for the public physician assumes that he work as dual practic physician.

The physicians from private facility sample can be differentiated into private physician and dual practice physicians. The total income of dual practice physician comes from the private practice questionnaire number A21B, “What is your overall montly income from all practices you have?”. The answer of the question will be identified to be a total income of private physcian if the physician does not have any duties in public facility, and identified as total income of dual practice if the physcian indicates having a job in public facility as well. Among 380 physicians in the private facility sample, 57 percent of them are dual practice physicians. The estimation result (see Table 4C.4 of Appendix 4C for the complete output) is:

$$\begin{aligned} Ln\ Dual\ practice\ income \\ &= 0.2477796 Sex + 0.2404429 Dual\ practice \\ &+ 0.2320271\ income\ from\ one\ private\ practice \\ &+ 12.20164 \end{aligned} \quad \textbf{(4. 14)}$$

By putting the dual practice variable to 1, it will indicate the estimate income for the dual practice as the variable identify 1 as dual practice and 0 for the non dual practictioner. We also put the variabel of income from one private practice, to measure the average income from their private practice. The estimation values will place the dual practice income for the private physcian using the approach as if these physcians are working as dual practitioners.

The estimation process of alternative income considering endogeneity problem

We provide other method to estimate the income per sector of physician regardless his actual working sector. The estimation process is important to get good measurement for income variable in the main model of physician choice of working sector using alternative specific logistic model. The second model of income estimation (here we refer as Model 2) considers the endogeneity issue because neglecting the problem will provide false picture regarding sectoral total income of physician.

The previous estimation has different estimation equation based on data sources. One can argue that the alternative income from this estimation results dissimilar conclusions because this different treatment. Hence in this approach, we work on pooled physician data from public facility questionnaire and private facility questionnaire. The physician income is extracted from public facility questionnaire which is the summation of item number A5A and A10A, which are income of public salary and income from private practice. While it is extracted from the summation of item number A21A and A21B of private facility questionnaire which are income from main job and income from all private practices.

The approach will be used to estimate the physician income in public and private sector. The specification is,

$$lnw_{1i} = X_i\beta_1 + \epsilon_{1i} \tag{4. 15}$$

$$lnw_{2i} = X_i\beta_2 + \epsilon_{2i} \tag{4. 16}$$

$$I_i^* = \delta(lnw_{1i} - lnw_{2i}) + Z_i\gamma + u_i \tag{4. 17}$$

The I_i^* is a latent variable that determines the sector where physician i mainly work or getting his main income; w_{ji} is the physician i income in sector j; Z_i is the vector that characterized the physician's sector to work. The X_i is the physician's characteristics that will influence physician's total income. The β_1, β_2, γ are vector pf parameters, and u_i, ϵ_1, ϵ_2 are disturbance terms. The latent variable of I_i^* is observed using the observable variable of I_i, whether physician is working in public or private sector follows,

$$\begin{aligned} I_i &= 1 \; if \; I_i^* > 0 \\ I_i &= 0 \; otherwise \end{aligned} \tag{4. 18}$$

In this framework, the physician's main working sector is endogenous to total income. There are unobservable characteristics influences physician's main sector might also affecting the physician's total income once any particular working sector is selected. Considering the endogeneity assumption will correct the selection bias in sectoral physician's income estimation. Using simultaneous ML, the sectoral total income of physician will be estimated.

The physician choice of sector is 1 if physician's main income comes from public sector and zero if it comes from private sector. The total income equation will estimate log of monthly total income of physician. The exogenous variables in total income regressions are physician characteristics (gender and years of experience), and regional dummies (urban and java). The physician sector identification involves two binary variables of education and local language ability. These variables will affect physician sectoral working choice but not the total income. The simultaneous ML is applied in Stata command of "movestay". The command implements the full-information maximum likelihood method to simultaneously fit binary and continuous part of the model to get consistent standard errors (Lokshin & Sajaia, 2004). The estimation for income in public sector is,

$$LnIncome = 0.230Gender - 0.206Urban - 0.167Java - 0.010YearsofExperience + 16.156 \quad \textbf{(4. 19)}$$

While the estimation for income in private sector is,

$$LnIncome = 0.158Gender - 1.045Urban - 0.208Java - 0.018YearsofExperience + 18.667 \quad \textbf{(4.20)}$$

The complete output of getting these equations is Table 4C.5 of Appendix 4C. After getting the total income estimation for public and private sector, the total income of dual practice sector is the summation of total income in public and private sector. We match the total income estimation to the original data set so that each physician will have complete information of total income from the actual working sector (observable data) and the alternatives income from the other two sectors assumed that he work in these sectors (total income from estimation procedure).

4.5.3 Physician characteristics

There are 920 physicians in the sample from the IFLS data. The descriptions are available in Table 4.1. Almost half of them or about 53% are dual practice physicians, 23% of physicians work in private only, and 24% of physicians work in public sector only. In general, our sample confirms the fact that most physicians in Indonesia are engaging in dual practice. Our sample consists of 57% female physician and 43% male physician. The sample has been corrected from anomaly entries in data set by excluding the case with outlier or extreme values. For example, variable of primary income and experience contain outliers that can be conformed into the survey code book. These outliers represent the codes for non-responds and out range values, therefore we removed them.

Table 4. 1 The descriptive statistics of physician characteristics

Variables	Number of sample (percentage)
(1)	(2)
Physician	
Private	216 (23.48)
Public	218 (23.70)
Dual practice	486 (52.83)
Education	
Graduated from 5 famous medical school	295 (67.93)
Graduated from other medical school	625 (32.07)
Gender	
Male	398 (43.26)
Female	522 (56.74)
Language	
Speaking local language	873 (95.10)
Not speaking local language	45 (4.90)
Java	
Yes	673 (73.15)
No (Non-Java Island)	247 (26.85)
Location Urban/rural	
Urban	797 (86.63)
Rural	123 (13.37)

The physicians' representation based on geographic identification shows that most of them, about 87% work in urban area; only 13% work in rural area. The difference gap between urban rural assignment of the physician is prevalent in Indonesia where most physician usually prefer urban area to live or to work, some because of broader opportunities in private market and some are because of practical reasons such as better environment or supporting facilities. Indonesian consists of thousands island but most of the Indonesian population lives in Java island. The size of Java Island is only around 7% from total area of Indonesian but about 60% of Indonesian population lives in Java Island. About 73% physicians of our sample are in Java Island and only about 27% is outside Java Island.

The physicians in our sample are also differentiated based on the origin of the medical school. We naturally followed the classification as appears in the questionnaire whether physicians graduated from well-known medical school. These are among the top five medical schools and also categorized as the best medical schools in Indonesia. In 2014, there are 73 medical schools both public and private medical schools. Only around 32% of the physicians graduated from 5 well known medical schools while the rest of them graduated from other medical schools.

The cross tabulation between variables provides more precise description on physicians. Table 4.2 shows cross tabulation between variables and physician's category. Among male and female physicians, being dual practice physicians are still the most favourable choice, with percentage of male physician being dual practice is 59.55%, and it is higher than female physician that is 47.70%. Female physician has higher percentage of being a public physician of 35.82% and it is higher than being private physician which is 16.47%. The percentage of male physicians who choose for being private physicians is 32.66%, and it is higher than being public physician (7.79%). The high percentage of female physicians being public physicians might be caused by a common knowledge of working in public facility that it provides stable income as civil servant and less pressure workloads compare to work in private sector.

We classified physician's residence based on urban-rural and Java-Non Java Island. Physician chooses to work as dual practice in Non-Java Island has higher percentage of 64.37% than in Java Island with 48.59%. Physicians in rural area who choose being dual practice is 76.42%, while the percentage of dual practice in urban area is 49.18%. The strictly difference percentage appears on the percentage of private physician, where the urban area has as much as 25.73% of private physicians compare to 8.95% of private physician in rural area. This percentage indicates important role of dual practice physician in providing health care service in Non-Java Island and rural area rather than Java Island and urban area.

Table 4. 2 Cross tabulation between variables and physician's choice

Variables	Number of Physicians (percentage)			TOTAL (percentage)
	Private	Public	Dual Practice	
(1)	(2)	(3)	(4)	(5)
Gender				
Male	130(32.66)	31(7.79)	237(59.55)	398(100)
Female	86(16.47)	187(35.82)	249(47.70)	522(100)
Education				
Graduated from 5 famous medical school	64(21.69)	77(26.11)	154(52.20)	295(100)
Graduated from other medical school	152(24.32)	141(22.56)	332(53.12)	625(100)
Language				
Speaking local language	206(23.60)	202(23.14)	465(53.26)	873(100)
Not speaking local language	10(22.22)	15(33.33)	20((44.45)	45(100)
Java	175(26.00)	171(25.41)	327(48.59)	673(100)
Non-Java Island	41(16.60)	47(19.03)	159(64.37)	247(100)
Rural	11(8.95)	18(14.63)	94(76.42)	123(100)
Urban	205(25.73)	200(25.09)	392(49.18)	797(100)

Indonesia has as many as 652 identified local languages not included dialect and sub dialect, but it has 733 local languages based on the accumulation of regional language spread by province. The most spoken local language is Javanese with almost 84 Million out of 231 Million populations in Indonesia. The ability to speak in local language indicates whether physicians came from the same native area with the area of assignment. Other indication might be the physician adaptive skill in order to ease the examining process with the locals. Most of the physicians, about 95% of the sample are speaking local language and most of them are dual practitioners. It seems that mastering local language is a common thing for physicians.

The cross tabulation between physician choice and education shows similar pattern between physician from well-known medical schools and other medical schools. Both categories shared almost the same percentage of physician working as dual practitioners, about 52% to 53%. It shows that being dual practice is still a popular choice of practice among physicians without looking into their education background.

Table 4. 3 Statistics summary of variables

Variable	observations	Mean	Standard Deviation	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
Main income (all sample)*	818	8.16	14.36	.54	300
Main income (Private physician)*	191	13.47	27.48	0.70	300
Main income (Public physician)*	188	7.98	6.08	0.54	39
Main income (Dual practice physician)*	439	5.92	4.89	1.00	60
Total income of private physician	213	14.2	9.09	1.60	90
Total income of public physician	218	7.86	5.72	0.54	39
Total income of dual practice physician	485	15.90	10.30	1.60	69
Experience (years)	863	15.90	9.97	0	48
Percentage of elderly	918	5.26	2.20	2.16	13.44
Physician ratio	892	7,928.79	13922.65	498.60	182,460

*Unit currency is Million Indonesian Rupiah (IDR)

On the average, a physician gets 8 million IDR per a month from primary work without considering whether the primary job is from public or private sector (Table 4.3). The question on physician's income in the IFLS questionnaire is a single question and filled based on physician's answer without any other approach questions. The physician will be asked on the income of his primary work. For the public or private physicians, the answer represents their income from public or private sector. The dual practice physician however, as physician has dual jobs both in public and private sector, the answer of main income represents the income from one of sector that he considered as a main job. The average of main income that is differentiated between main income of private, public, and dual practice means that the value represents the main income for physician that is indicated as private, public or dual practice. The primary income of private physician is higher compare to primary income of public physician. The average main income of private physician is around 13 million IDR, while in public physician is around 8 million IDR. The dual practice physicians have an average of main income about 6 Million IDR, which is the lowest average among the three categories. It should be noted that main income represents one income side of dual practice physician, whether it comes from public sector or private sector. In our case, it seems that the main income of dual practice comes from public sector. This refers to the physician structure job in Indonesia that physician usually works in public sector and then open private practice. This is also showed in the data that most of dual practice physicians stated that their primary job is in public sector. The total income that reflects a monthly physician's take home pay shows that the dual practice physician has the average income of 15.9 Million IDR, while the public physician and private physician has the average of 7.86 Million IDR and 14.20 Million IDR. The total income has cleared out from extreme values and missing values by imputation process using the average of physician per sector in the same area.

From Table 4.3, the average experience of the physicians in the sample is around 16 years. This figure represents a number of years that the physician graduates from medical school. From the tabulation result in Table 4.4, the physicians with experience years below the average has higher proportion on working as dual practitioners compare to the physician with the experience years above the average. The physicians with more experience above the average are working more as private physicians rather than public physicians. The fact is contrast to the physicians with experience below average where more physicians working as public physician rather than working as private physicians.

The potential demand factor in Table 4.3 shows that the average percentage of elderly population aged 65 years and above is 5%, with interval from 2% to 13%. The physician ratio ranges from 499 residents per physician to 182,460 per physician. The median of physician ratio is 7,929 residents per physician. This figure indicates that there is large difference of potential demand among areas. Physicians seem to have different workloads based on the area where they reside.

Table 4. 4 Number and percentage of physician distribution below and above the average experience

Experience (years)	Private physician (percentage)	Public physician (percentage)	Dual practice physician (percentage)	Total
(1)	(2)	(3)	(4)	(5)
Below average(15.9)	97(20.59)	103(21.87)	271(57.54)	471(100)
Above average (15.9)	119(26.50)	115(25.61)	215(47.88)	449(100)
Total	216	218	486	920(100)

The description of physician's experience year with physician working decision is provided by grouping the experience years into ten years of interval as appears in Table 4.5. The experience years bellow 30 shows that being dual practice is still being most of the physician's option. It means that in general physicians are favouring the dual practice starting in the early stage of his career. In the higher interval, it shows that most of physicians choose to work in private sector; even in the experience more than 40 years shows that none of the physician works as public physicians. This is because the physicians are in the retirement age of being public physician, which is 60 years in

Indonesia. The number can also be interpreted that some of the retired physicians in the public still working as a private physician.

Table 4. 5 Number and percentage of physician distribution based on experience and working place

Experience (years)	Number of Private physician (percentage)	Number of Public physician (percentage)	Number of Dual practice physician (percentage)	Total
(1)	(2)	(3)	(4)	(5)
<10	67(27.02)	56(22.58)	125(50.4)	248(100)
10-<20	49(14.98)	65(19.88)	213(65.14)	327(100)
20-<30	43(20.57)	63(30.14)	103(49.29)	209(100)
30-<40	37(63.80)	8(13.80)	13(22.40)	58(100)
40++	19(90.48)	-	2(9.52)	21(100)

The cross tabulation in Table 4.6 shows that physician who have main income below average has the highest percentage of being dual practitioners rather than working as public physician or private physician.

Table 4. 6 Number and percentage of physician distribution below and above the average main income

Main income (Million IDR)	Private physician (percentage)	Public physician (percentage)	Dual practice physician (percentage)	Total
(1)	(2)	(3)	(4)	(5)
Below average(8.32)	105(17.47)	127(21.13)	369(61.40)	601(100)
Above average (8.32)	111(34.80)	91(28.53)	117(36.68)	319(100)
Total	216	218	486	920(100)

The percentage difference is striking, with 61% of physicians are dual practice physicians, while only 21% of physicians are private physician and 22% of physicians are public physician. In the different group where physicians are in the higher level of main income, being dual practice is still physician's favourite with around 37% of physicians although it has slightly different with working in private sector with about 35% of physicians. The least percentage is working as public physician.

4.6 Results

4.6.1 The result of main model

The main model requires income data in alternative choice by physicians. This information is not provided during the IFLS survey hence the estimation process is needed. Using this process on main income data, a physician will have full set information of income if physician working in the different working places from the actual one. For example in the data from the survey, a physician work in private sector, hence the information on the main income comes from the actual income in private facility.

Table 4. 7 The descriptive statistics for the physician income based on estimation process and sector *

Income of being	Obs	Mean	Std. Dev.	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)
Estimation process of Model 1					
Private physician	920	9.80	8.83	0.0005	120
Public physician	920	7.09	3.49	0.54	39
Dual practice physician	920	15.28	9.64	0.6	100
Estimation process of Model 2					
Private physician	920	43.32	28.95	0.175	147.42
Public physician	920	8.07	3.34	0.54	44
Dual practice physician	920	40.77	33.71	0.175	160

*in Million IDR. The estimation process of Model 1 uses linear regression, while Model 2 is the model after correction to endogeneity problem.

The estimation process provides the income estimation for the physician if he works in public facility and if he works in dual practice facility. At the end of the process, we have a full set of income information, from the observed physician choice and the alternatives for all 920 physicians in the full sample. The income descriptive statistics per sector using two models of estimation appears in the Table 4.7. The estimation without correcting the endogeneity shows that among the three working choices, the average income of dual practice physician is the highest income, which is 15.29 Million IDR, while being a public physician is the lowest average income with 7.09 Million IDR. After correcting the endogeneity issue in the estimation model, the result shows that the alternative income per sector is higher than previous approach. Both estimation process of alternative of physician per sector shows similar outcome with public physician has the least income but the average of private physician is higher than dual practice physician.

The result of alternative specific conditional logit estimation with dual practice as base category appears in Table 4.8, while the relative risk ratio appears in Table 4.9. Income variable positively affects the physician decision of working place. Although it appears slightly higher than one in term of odds ratio in Table 4.9, the increasing income per sector has positive effect for physician working in related sector. The result shows statistical significance but it provides small effect in term of economic magnitude. One unit increase in income will increase 0.06 the likelihood of physician working in the particular sector. Using the odds ratio in Table 4.9, the increasing of one Million IDR of public physician income, the odds of physician in choosing this sector is increasing by 6% while holding all other variables in the model constant. Here we can see that the percentage of likelihood is actually relatively small and one can argue that the percentage of physician working in particular sector is small in magnitude although it is showing the positive significant sign.

Table 4. 8 Parameter estimates of asc multinomial logit

Variable	Model1		Model 2	
	Public	Private	Public	Private
(1)	**(2)**	**(3)**	**(4)**	**(5)**
income	0.06^{**}	0.006^{**}	0.053^{***}	0.053^{***}
	(0.009^{*})	(0.002)	(0.004)	(0.004)
male	-1.584^{***}	0.598^{**}	-1.635^{***}	1.008^{***}
	(0.249)	(0.191)	(0.270)	(0.199)
education	0.127	-0.590^{**}	0.216	-0.647^{**}
	(0.224)	(0.217)	(0.240)	(0.221)
language	-0.516	-1.127	-0.711	-0.160
	(0.425)	(0.480)	(0.478)	(0.515)
urban	-0.042	1.276^{**}	-2.885^{***}	1.734^{***}
	(0.358)	(0.414)	(0.524)	(0.481)
Java	0.618^{**}	1.011^{***}	0.225	$1..108^{***}$
	(0.245)	(0.234)	(0.270)	(0.248)
experience	0.005	0.041^{***}	0.001	0.045^{***}
	(0.011)	(0.009)	(0.011)	(0.009)
Percentage of elderly	-0.258^{***}	-0.143^{**}	-0.222^{***}	-0.109^{*}
	(0.054)	(0.047)	(0.057)	(0.050)
Physician ratio	-0.00002^{**}	-0.00001	-0.00002*	-0.00001
	(0.00001)	(0.000009)	(0.00001)	0.000009
_cons	1.426^{**}	-2.233^{***}	5.152^{***}	-3.496^{***}
	(0.604)	(0.679)	(0.819)	(0.744)
N	2505	2505	2505	2505

i. Standard errors in parentheses
ii. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.001$
iii. Model 1 uses alternative income from linear regression estimation without correction of endogeneity. Model 2 uses alternative income from estimation process with correction of endogeneity.
iv. Number of observations in Model 1 and Model 2 is 835 physicians that resulted in 2505 cases for all possible working choice.

Table 4. 9 The odds ratio of the main model

Variable	Model 1		Model 2	
	Odds Ratio		Odds Ratio	
Income	1.059		1.055	
	(0.009)		(0.005)	
Variables	Public	Private	Public	Private
(1)	**(2)**	**(3)**	**(4)**	**(5)**
Male	0.20	1.81	0.19	2.74
	(0.051)	(0.347)	(0.052)	(0.545)
Education	1.13	0.55	1.24	0.52
	(0.254)	(0.120)	(0.298)	(0.116)
Language	0.59	0.88	0.49	0.85
	(0.253)	(0.423)	(0.235)	(0.439)
Urban	0.96	3.58	0.05	5.66
	(0.343)	(1.483)	(0.029)	(2.727)
Java	1.85	2.74	1.25	3.03
	(0.454)	(0.644)	(0.334)	(0751)
Experience	1.00	1.04	1.01	1.05
	(0.011)	(0.010)	(0.011)	(0.010)
Percentage of elderly	0.77	0.86	0.80	0.90
	(0.041)	(0.040)	(0.045)	(0.042)
Physician ratio	0.99	0.99	0.99	0.99
	(0.00001)	(0.000008)	(0.00001)	(0.000008)

* Standard errors in parentheses.
**Based on the result in Table 4.8. Model 1 uses alternative income from linear regression estimation without correction of endogeneity. Model 2 uses alternative income from estimation process with correction of endogeneity.

The male physician is less likely working as a public physician over working as a dual practice then female physician, but the male physician is more likely being private physician over being a dual practitioner. The result supports the conclusion that female physician are less interested in dual job due to the working loads while public sector seems more attractive for female physician as it is offered less working pressure and more time for family. Physician graduated from top five medical schools in Indonesia is more likely working as a private physician over being dual practice then physician graduated from other medical schools. Physician lives in the urban area, and Java Island is more likely to be private physician over the dual practice. The effect of location is also significant for Java variable in the comparison between public and dual practice. Physician in Java is more likely to work in public over the dual practice. The increasing of physician's experience increases the likelihood that he will work in one sector only, public or private; the effect of having more years of experience is the same for these two choices of work. The increasing percentage of elderly population in the area decreases the likelihood that physician will work in one sector only, public or private. This shows us that the more potential demand of health care leads to decision working as dual practice. The rise of physician ratio decreases the likelihood of physician working in public or private only. The increasing of physician ratio means that one physician will serve more people and in this situation the physicians prefer being dual practice rather to engage in one sector only. The increasing of physician ratio can be translated that the number of physicians is less in the area, therefore physicians are more attracted on becoming dual practitioners.

The marginal effect of income for each alternative in Table 4.10 gives a clearer picture of how income per sector effects on physician decision. The result shows that the increasing income in each sector, whether it is public, private of dual practice, gives the indication of increasing probability for physician to work in the particular sector. For example, the increasing income in public sector will increase the probability of physician choosing this sector, while the probability of physician choosing for private sector or being dual practice is decreasing. The increasing income in private sector also leads the increasing probability of physician working in private sector while the probability of choosing public and dual practice is decreasing. The same goes to the increasing income in dual practice sector. The value of probability however is relatively small although shows significant effect, for example using the income estimation of Model 1, for each Million increasing in public salary, the increasing probability of physician choosing in this sector is 0.0059, while the decreasing probability to work in dual practice and private sector are 0.0081 and 0.0023, while holding other variables at their average values.

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Table 4. 10 The marginal effect of income from the main model*

Pr(choice = dualpr|1 selected) =			Pr(choice = pub|1 selected) =		Pr(choice = pv|1 selected) =	
variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	0.5977	0.6126	0.1704	0.1474	0.2319	0.2400
	dp/dx	dp/dx	dp/dx	dp/dx	dp/dx	dp/dx
Income:						
dual practice	0.0138	0.0126	-0.0059	-0.0048	-0.0080	-0.0078
public	-0.0059	-0.0048	0.0081	0.0067	-0.0023	-0.0019
private	-0.0080	-0.0078	-0.0023	-0.0018	0.0100	0.0097

* All the P>|z| =0.000
**The marginal effect using the result in Table 4.8.
***Model 1 refers to the estimation process in getting alternative income using linear regression. Model 2 refers to estimation process after correcting for the endogeneity.

The predicted probability for income of physician per sector also appears in Figure 4.1, it is based on the result of Model 1. Under all variables at their mean, the increasing income per sector leads physician to work in that particular sector. For example, when public salary is increasing, physician prefer this sector compare to other two sectors. The predicted probability in private income shows slower increasing rate compare to other two sectors. The increase in public sector has relatively sharp pattern of increase in the early values of public salary.

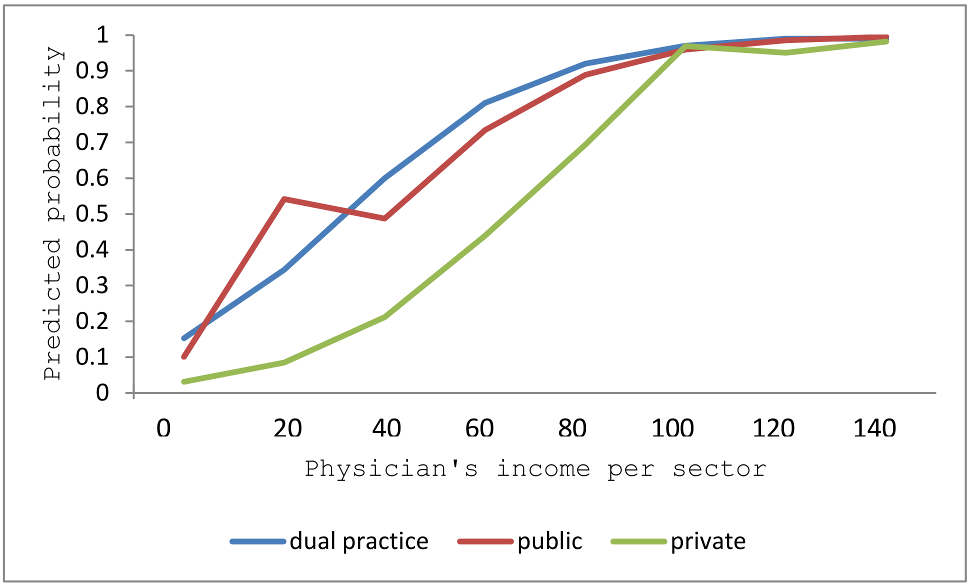


Figure 4. 1 Predicted probability of physician choice and years of experience using the main model (Model 1)

The marginal effect of case specific variables in Table 4.11 shows the marginal effect of particular variable when other variables are at their mean. There is indication that male physicians have higher preference in working in private sector and dual practice sector than female physician but lower preference for working in public sector. Physician in urban area has lower preference in working dual practice and has high preference in private sector compare to physician resides in rural area. Physician in Java Island has less preference working in dual practice then physician in Non-Java Island. The different preference appears for physician in Java Island working in public and private sectors, that physician in Java Island has higher preference to work in both sectors then physician in Non-Java island. It is indicated that public and private sector is more attractive for physician in Java Island, while dual practice is more attractive for physician in Non-Java Island.

Table 4. 11 The marginal effect of variables in main model

Pr(choice = dualpr|1 selected) =			Pr(choice = pub|1 selected) =		Pr(choice = pv|1 selected) =	
variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	0.5977	0.6126	0.1704	0.1474	0.2319	0.2400
	dp/dx (P>|z|)	dp/dx (P>|z|)	dp/dx (P>|z|)	dp/dx (P>|z|)	dp/dx (P>|z|)	dp/dx (P>|z|)
Gender	0.0687	-0.0117	-0.2360	-0.2299	0.1673	0.2417
	(0.076)	(0.781)	(0.000)	(0.000)	(0.000)	(0.000)
Education	0.0629	0.0673	0.0410	0.0504	-0.1036	-0.1177
	(0.1350	(0.126)	(0.201)	(0.016)	(0.001)	(0.000)
Language	0.0763	0.0986	-0.0783	-0.1021	0.0020	0.0035
	(0.413)	(0.353)	(0.278)	(0.190)	(0.980)	(0.967)
Urban	-0.1283	0.3562	-0.0450	-0.6315	0.1732	0.2751
	(0.036)	(0.000)	(0.431)	(0.000)	(0.000)	(0.000)
Java	-0.1900	-0.1649	0.0496	-0.0047	0.1404	0.1696
	(0.000)	(0.000)	(0.092)	(0.883)	(0.000)	(0.000)
Experience	-0.0062	-0.0077	-0.0009	0.0004	0.00770	0.0077
	(0.001)	(0.000)	(0.545)	(0.978)	(0.000)	(0.000)
Percentage of	0.0460	0.0362	-0.0310	-0.0240	-0.0152	-0.0122
elderly	(0.000)	(0.000)	(0.000)	(0.000)	(0.061)	(0.140)
Physician ratio	0.000004	0.000004	0.000002	-0.000002	-0.000001	-0.000002
	(0.017)	(0.028)	(0.068)	(0.083)	(0.0358)	(0.328)

*The marginal effect using the result in Table 4.8.
**Model 1 refers to the estimation process in getting alternative income using linear regression. Model 2 refers to estimation process after correcting for the endogeneity.

The marginal effect of experience indicates that there is a lower chance for physician choosing dual practice with an increase in years of experience. There is a higher chance for physician choosing public sector and private sector with an increase in years of experience. We present the predicted probability pf physician choosing the working sector related with the years of experience in Figure 4.2. The predicted probability of physician choosing dual practice is decreasing along with the increasing years of experience. This suggests the conclusion that dual practice attracts fresh graduate physicians as dual practice provides larger benefits in term of physician experience and opportunity for physician to maintain the physician’s network. The same decreasing pattern with different steepness appears in predicted probability of physician working as public sector. It is also shown that public sector is attractive for fresh graduate, which is also relevant with the previous result on predicted probability of working in dual practice. The decreasing pattern is caused by the age limit when entering the public sector that is maximum 40 years in Indonesia. The different one happens in the predicted probability of physician working in private sector is increasing when physicians have longer years of experience. Physicians tend to enter private sector after gaining some years of experience. At the beginning of their career physicians choose to work in public sector or dual practice. After having more adequate experience, physician tends to work in private sector.

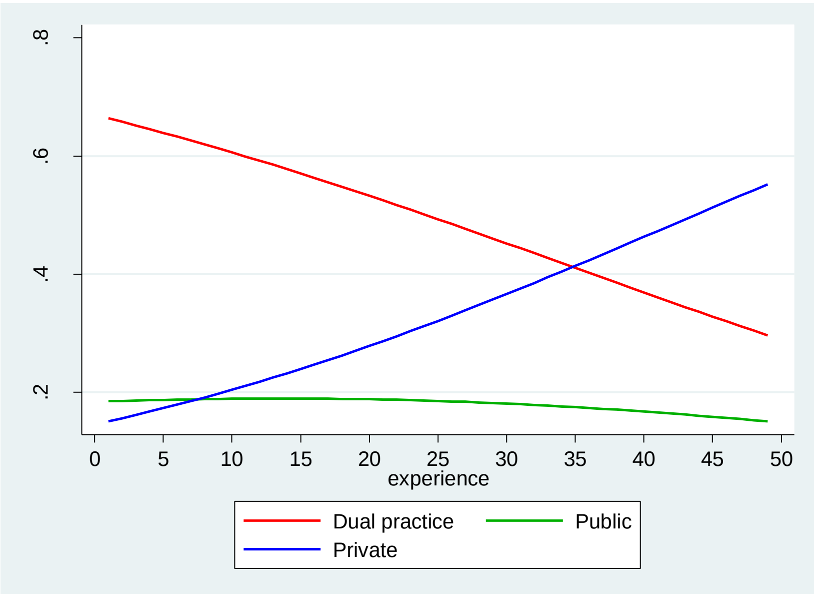


Figure 4. 2 Predicted probability of physician choice and years of experience based on Model 2

The marginal effect of percentage of elderly indicates that there is higher chance for physician working in dual practice with an increase in percentage of elderly. It reflects that potential demand of health care leads physician to work in dual practice. There is higher probability of physician working in dual practice with an increase of physician ratio. This indicates that the more population need health care, the physician has higher chance for being dual practice physician.

We also try to expand the hypothesis that income per sector has different implication to physician choice of working sector when it is analysed based on geographical identities (urban and Java island identification) and experience. We put the interaction term in the model between income per sector with java, income per sector with urban, and income per sector with experience. None of the interaction term is significant and the complete result can be found in the Appendix. The insignificant sign of interaction term might be explained from the data source of income per sector in our study. The income per sector contains the unobservable income from the alternative sectors that we approach using estimation process. In the composition process, the income per sector has already contained some influence from geographical identification and experience. Therefore the interaction term shows no significant effect on affecting physician choice of working sector.

4.6.2 The result of alternative model

The analysis of alternative model is done mainly to support the finding in our main model about factors that involving physician's decision to work in private facility, public facility, or dual practice. In this alternative model, we use the main income instead of physician income per sector. It is the physician income from one particular sector that is categorized as primary work based on physician acknowledgement. We employ multinomial logit regression assuming that main income is case specific variable so that it will vary among physicians. The alternative model includes 761 physicians due to the combination of incomplete case from several variables such as main income, experience, percentage of elderly, and physician ratio. The complete result of estimation is available in the Appendix.

The alternative model has advantage of omitted variable biased, because in this model, we use the main income information instead of income per sector. The main income variable is the observed variable as all physicians will report the income from his main job, whether it is public sector or private sector. The disadvantage of using the alternative model is that we have less data observations compare to the main model. The previous model has 920 observations to enter into regression, while in the alternative one, the number of observations is 761 physicians.

The statistics descriptive of the 761 observations that is used in the regression appears in Table 4B.1 to Table 4B.6 of the Appendix 4B. In general, the interpretation based on the descriptive statistics is similar with the interpretation of full sample in sub chapter 4.4.2. The first analysis is on the comparison between private and dual practice. Variables that statistically significant at different significance level start from 10%, 5% and 1% level are: the dummy variable of male, education, urban, Java, main income, and experience, while variables of language, population elderly and physician ratio are not significant. The second analysis involves the comparison between physician's choice being public physician and dual practice. It has fewer significant variables than first comparison of private and dual practice, which are: male, Java, main income, population elderly and physician ratio. The other variables such as education, language, urban, and experience are not significant at 5% or 1% level.

Table 4. 12 The Relative Risk Ratio of the alternative model

Variable	Private vs. dual practice	Public vs. dual practice
(1)	(2)	(3)
Male	1.53	0.16
Education	0.52	1.19
Language	0.64	0.49
Urban	4.23	1.25
Java	2.48	2.02
Main Income	1.07	1.04
Experience	1.03	1.00
Percentage of elder population	0.92	0.79
Physician ratio	0.99	0.99

* The alternative model is multinomial logit model.

The analysis of relative risk ratio might give a clearer insight of the model as it is provided in Table 4.12. It should be noted that in our study, becoming a dual practice physician is a choice and not a random risk. As shown in Table 4.12 column 2, the comparison between private and dual practice shows that male physicians are more likely than female physician to prefer working in private sector over dual practice. For physician in urban area relative to physician in rural area, the relative risk for preferring private sector relative to dual practice would be expected to increase by factor of 4.24 given the other variables held constant. Physicians in Java Island are more likely to work as private physician. . The interpretation for the risk ratio of main income and years of experience indicate that although it provides significant statistics result but it is not very high in term of economic magnitude. The result provides evidence for the effect of these variables to the dual practice decision but the importance level should be interpreted with cautions.

The second comparison is between public and dual practice as appears in Table 4.12 Column 3. Male physician will be more likely to choose being dual practice rather than being public physician while female physician is more likely for working in public sector only. The reason is that male physician is usually associated to have greater responsible to the family while female physician role is more to take care of family. Physicians in Java Island are more prefer to work in public sector compares to dual practice sector. Our results show that dual practice activities are more preferable for physicians living in rural and Non-Java Island. Thus based on physician's residence, dual practice policy is more relevant in those areas. The additional percentage of elderly population and physician ratio leads to dual practice activity among physicians. The result can be interpreted into two folds. The first one relates with the workloads or opportunity window for the physician. The percentage of older people represents the opportunity for the physician, as elderly might need more health care treatment compares to other age group. The more elderly group in particular area, the physicians has higher probability on working as dual practice compare to only working in public sector. The second explanation relates with physician reaction to the competition among physicians. Besides as a part of health indicator on physician availability in the area, the physician ratio also describes the competition among physician in the area. The coefficient from multinomial logit result shows that the lack of physicians in the area will have an implication on higher probability of physicians being dual practitioners. The result is in line with the field fact in the descriptive statistics although it is not convincingly showed in term of relative risk ratio.

The next analysis emphasizes the importance of main income as it is also appeared in the previous literature as important factor for physician working as dual practice. The explanations will lead to the suggestion that physicians prefer non-dual job work as long as the income particularly in private sector has already high enough. The marginal effect of primary job income in Figure 4.3 indicates that the higher income in primary job, the physician has a higher probability to involve in the private sector. In this figure, we describe the significance values as entirely appear in Table 4.13.

Table 4. 13 Predicted probability of income on choice of type of work using the alternative model

Main income level	Outcome=Private		Outcome=Public		Outcome=Dual practice	
	Margin	P[|Z|>z]	Margin	P[|Z|>z]	Margin	P[|Z|>z]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.5	0.18	0.00	0.20	0.00	0.62	0.00
5.5	0.22	0.00	0.22	0.00	0.56	0.00
10.5	0.26	0.00	0.23	0.00	0.50	0.00
15.5	0.31	0.00	0.24	0.00	0.44	0.00
20.5	0.37	0.00	0.25	0.00	0.38	0.00
25.5	0.42	0.00	0.25	0.00	0.32	0.00
30.5	0.47	0.00	0.25	0.00	0.27	0.00
50.5	0.66	0.00	0.22	0.02	0.11	0.07
100.5	0.90	0.00	0.09	0.40	0.006	0.49
150.5	0.97	0.00	0.03	0.63	0.0003	0.66
200.5	0.99	0.00	0.007	0.73	8.78e-06	0.75
250.5	0.99	0.00	0.002	0.79	3.01e-07	0.79

*The alternative model is multinomial logit model.

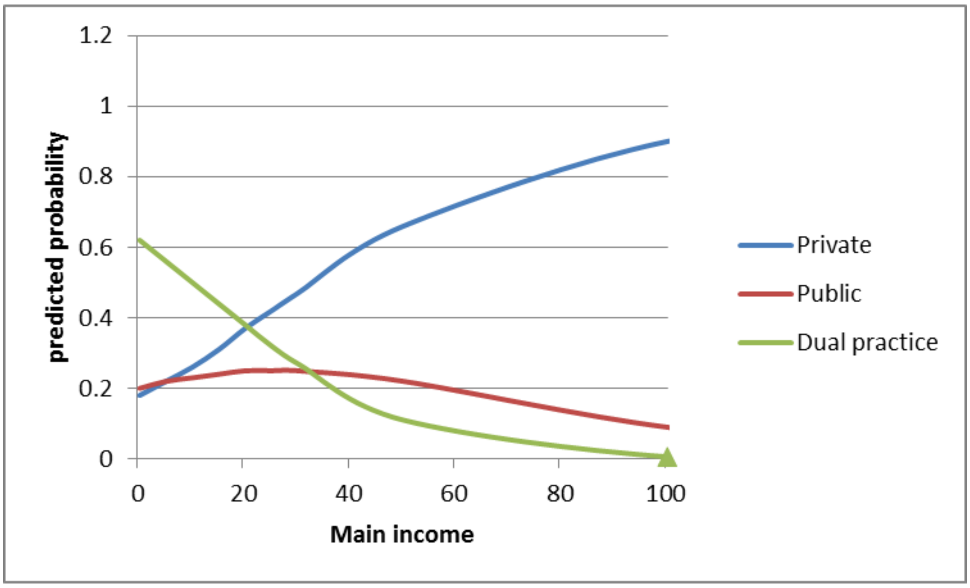


Figure 4. 3 Predicted probability of income using the alternative model

While for public and dual practice outcome, the increase in income of primary job gives the mix interpretation. The higher income in the primary job will increase the probability of physician to work in public sector only. However, the increasing probability changes into decreasing pattern after 28 million IDR of income level. The decreasing pattern continues until the marginal effect is no longer significant at 66 Million IDR income level. The possible explanation for the change of pattern is that physician starts working at a low-income level hence will be more likely to involve in the public sector, where this place can provide more stable condition and offers other conveniences such that training and reputation that will be a potential asset for the physician in the future. After certain of income level, working in public is less interesting; hence, the predicted probability is decreasing. The other explanation is that when physician working in public sector, the chance to gain a certain amount of high income is directly proportional with the position in public facility structure organization. It is common assumption that fewer positions offers such high salary or in this case is income. The predicted probability in dual practice outcome shows a physician prefers working in one sector only, public or private. The increasing main income is followed by a decreasing probability of physician being dual practice. Increasing main income causes working in one sector is more attractive for a physician compares with working as dual practice.

Income from primary jobs somehow provides difficulties in term of interpretation because we cannot directly address from which income sector affect physician decision between working in private, public, or dual practice. The primary jobs between public sector and private sector might give different treatment to handle. The governments for example will more interest with the main income from physicians who have primary job in public sector because it is closely related with the payroll policy for the public physicians. Later we will show the counterfactual analysis related with the salary from policy maker point of view.

To provide detailed analysis of public salary on the physician decision on being dual practice, we split the sample based on the sample sectors that are public or private. The public sector sample comes from public community health centre, a government owned health care facility that mainly provides primary care in the sub-district level. The sample consists of 540 physicians and identifies as public physician or dual practice. Almost 60% of them are involving in dual practice activities. The detailed descriptive of the sample from public facility is available in the Appendix 4B, Table 4B.7 and Table 4B.8, while the descriptive statistics of private sample is in Table 4B.10 and Table 4B.11 of Appendix 4B.

The effect of public salary on the physician decision of being dual practitioners will be analysed using the logit regression between dependent variable of physician working as public physician or dual practice and the same explanatory variables that appear in the main model with the exception that in this regression we use the public salary to represent the physician's income. The detailed result of logit regression is available in the Appendix 4B, Table 4B.9. We shows the predicted probability of being dual practice in the physician public sample using a logit model to get a clearer picture of the effect of public salary on physician decision to become dual practice in Table 4.14.

Table 4. 14 Predicted Probability of choosing dual practice using pooled sample and public physician sample using the alternative model

Public salary level (Million IDR)	Predicted Probability from Multinomial logit (pooled sample)*		Predicted Probability from logit (public physician sample)**	
	Margin	P[|Z|>z]	Margin	P[|Z|>z]
(1)	(2)	(3)	(4)	(5)
0.5	0.59	0.00	0.66	0.00
1.5	0.58	0.00	0.65	0.00
2.5	0.58	0.00	0.65	0.00
3.5	0.58	0.00	0.64	0.00
4.5	0.58	0.00	0.63	0.00
5.5	0.57	0.00	0.62	0.00
6.5	0.57	0.00	0.61	0.00
7.5	0.57	0.00	0.59	0.00
8.5	0.56	0.00	0.58	0.00
9.5	0.56	0.00	0.57	0.00

*The pooled sample is 761 observations
**The public physician sample is 419 observations
***The alternative model is multinomial logit model.

The interpretation confirms the result that the increasing public salary will decrease the predicted probability of public physician from being dual practice. The table is the comparison of predicted probability of being dual practice physician on several levels of income. The interesting result appears in the marginal effect of experience. We provide further explanation based on Table 4.15.

Table 4. 15 The predicted probability of outcomes using the alternative model

Variables	Outcome=Private		Outcome=Public		Outcome=Dual practice	
	Margin	P[|Z|>z]	Margin	P[|Z|>z]	Margin	P[|Z|>z]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rural	0.08	0.00	0.18	0.00	0.73	0.00
Urban	0.27	0.00	0.17	0.00	0.55	0.00
Non Java	0.15	0.00	0.13	0.00	0.71	0.00
Java	0.28	0.00	0.19	0.00	0.53	0.00
Experience						
0 years	0.18	0.00	0.23	0.00	0.59	0.00
10 years	0.21	0.00	0.22	0.00	0.56	0.00
20 years	0.25	0.00	0.22	0.00	0.53	0.00
30 years	0.29	0.00	0.21	0.00	0.49	0.00
40 years	0.35	0.00	0.19	0.00	0.45	0.00
50 years	0.39	0.00	0.18	0.00	0.42	0.00

*The alternative model is multinomial logit model.

The more years of experience, the probability of choosing dual practice will be lower, but in the different side, the probability of physician being a private physician is increasing. The predicted probability of working in public is decreasing along with the increasing of experience. The rate of decreasing probability in public is slow in the public sector to compare to the rate of increasing probability in private or decreasing rate in dual practice. The decreasing rate of working in public sector indicates that public sector usually attracts physicians who just start their early career. The public sector usually provides benefit on training opportunities and experience in spite of the usual issue on the low salary level in public sector. The result also confirms the fact that senior physician will be less likely to work as a dual practice and prefers to private sector. One typical example for this case is that a senior physician who usually works in public sector as a civil servant and dual practice then he retires and continue working in private sector only.

The interpretation of predicted probability of geographic identification supports our previous result on coefficient estimation. Physicians in rural area and Non-Java Island have higher probability of being dual practice rather than physician in urban and Java Island. Being private physician is more interesting for physician in urban area compare to physician in rural area.

4.6.3 Robustness check

We provide robustness check for the main model. The fit statistics for Model 1 and Model 2 are in Table 4.16.

Table 4. 16 The fit stat result for the main model

	Model 1	Model 2
Wald chi2(17)	208.87	256.66
Prob > chi2	0.0000	0.0000
LR chi2(19)	439.24	548.082
Prob > LR	0.0000	0.0000
R-Squared		
McFadden	0.24	0.30
McFadden(adjusted)	0.22	0.28
AIC	1433.45	1324.601
BIC	1544.14	1435.296

*Fit stat for the result in Table 4.8

** Model 1 refers to the estimation process in getting alternative income using linear regression. Model 2 refers to estimation process after correcting for the endogeneity.

The Wald test of physician’s choice of working sector using the alternative income from linear regression and estimation after correcting for endogeneity show that the coefficients are not simultaneously equal to zero therefore including all variables related create a statistically significant improvement in the fit of the model. The LR test of both models shows that adding all variables together results in a statistically significant improvement in model fit. The main model can explain the physician's choice between private, public, and dual practice. We also reports the Akaike's Information Criterion (AIC) and The Bayesian Information Criterion (BIC) statistics to compare between Model 1 and Model 2 in the main model. The model 2 which uses the estimation process after correcting the endogeneity provides better model than Model 1. It also better model compares to the alternative model. The McFadden R-squared indicates that the model can predict about 30% of the outcome.

Table 4. 17 The result of VIF for the main model

Variables	VIF	Tolerance	VIF	Tolerance
(1)	(2)	(3)	(4)	(5)
Dual practice	1.08	0.93	1.10	0.91
Male	1.05	0.95	1.07	0.94
Education	1.18	0.85	1.18	0.85
Language	1.03	0.97	1.03	0.97
Urban	1.19	0.84	1.24	0.80
Java	1.15	0.87	1.15	0.87
Income	1.11	0.90	1.19	0.84
Experience	1.11	0.90	1.11	0.90
Population elderly	1.17	0.86	1.17	0.86
Physician ratio	1.08	0.92	1.08	0.92
Mean VIF	1.11			

*The VIF for the result in Table 4.8

** Model 1 refers to the estimation process in getting alternative income using linear regression. Model 2 refers to estimation process after correcting for the endogeneity.

We test the model for collinearity which might cause a standard error to be inflated. The Variance Inflating Factor (VIF) in Table 4.17 is around one, and therefore a tolerance of

VIF is higher than 0.5 (1/VIF). However, our model does not suffer from inflated standard errors, and the mean VIF at 1.11 is satisfactory.

The alternative specific conditional logit model that is a discrete model with more than two categories in outcome requires the satisfaction of the independence of irrelevant alternatives (IIA) assumption. The test for IIA uses a Hausman test, a Suest-based Hausman test or a Small-Hsiao test, in Table 4.18. The Hausman test provides the Chi2>0 and therefore our model meet the asymptotic assumptions of the test. It cannot reject the null hypothesis at the 5 percent level. Therefore the main model is not violated the IIA assumption.

Table 4. 18 The Hausman test of IIA assumption for the main model

Outcome	Model 1			Model 2		
	chi2	df	P>chi2	chi2	df	P>chi2
(1)	(2)	(3)	(4)	(2)	(3)	(4)
private	27.62	9	0.0006	1.71	8	0.9887
public	9.38	9	0.3109	305.42	8	0.0000
dual practice	122.62	9	0.0000	30.83	8	0.0002

*The Hausman test for the result in Table 4.8
** Model 1 refers to the estimation process in getting alternative income using linear regression. Model 2 refers to estimation process after correcting for the endogeneity.

We perform the measurement of fit and diagnostics check for the Multinomial Logistics regression as the alternative model in Table 4.19. The purpose of robustness check in this sub section allows us to justify the validity of the results. It is also completed with statistical evidence to support our selected estimation process. The variables turn out to be significant at the margin, and also the overall decision for a physician to engage in working place can be captured in the model.

Table 4. 19 The result of fit stat for the alternative model

Log-likelihood	
Model	-645.85
Intercept-only	-768.88
Chi-square	
Deviance(df=741)	1291.71
LR(df=18)	246.05
p-value	0.00
RSquared	
McFadden	0.16
McFadden(adjusted)	0.13
AIC	1331.71
AIC divided by N	1.75
BIC (df=20)	1424.39

*The fit stat for the result in Table 4.12
** The alternative model is a multinomial logit model.

Table 4. 20 The result of VIF for the alternative model

Variables	VIF	Tolerance
(1)	(2)	(3)
Dual practice	1.16	0.86
Male	1.05	0.95
Education	1.20	0.93
Language	1.03	0.97
Urban	1.21	0.83
Java	1.19	0.83
Main Income	1.07	0.94
Experience	1.11	0.90
Population elderly	1.19	0.84
Physician ratio	1.09	0.91
Mean VIF	1.13	

*The VIF for the result in Table 4.12
** The alternative model is a multinomial logit model.

As indicates in Table 4.20, the alternative model does not suffer from inflated standard errors, and the mean VIF at 1.137 is satisfactory. To test for independent variables, we run the likelihood ratio test (lr) as well as a Wald test (Wald) in Table 4.21.

Table 4. 21 The LR tests of alternative model for independent variables

Variables	pchi2	df	P>chi2
(1)	(2)	(3)	(4)
1.male	83.732	2	0.000
1.educ1	11.756	2	0.003
1.language	2.661	2	0.264
1.urban	14.042	2	0.001
1.java	18.760	2	0.000
Main income	30.119	2	0.000
experience	7.630	2	0.022
Percentage of elderly	17.903	2	0.000
Physician ratio	7.321	2	0.026

*Number of observations=761
**The LR test for the result in Table 4.12
*** The alternative model is a multinomial logit model.

Both test the null hypothesis whether all coefficients associated with the given variables are in fact zero (Williams, 2015). Both tests reject the null hypothesis for all variables at the 5% level except for the language variable. For this one, the null hypothesis can be rejected at the 5% level. Hence each variable's effects are highly significant in the model.

Table 4. 22 LR tests of alternative model for combining alternatives

Comparison	chi2	df	P>chi2
(1)	(2)	(3)	(4)
private &public	111.77	19	0.000
private &dual practice	114.348	9	0.000
public &dual practice	137.228	9	0.000

*The LR test for the result in Table 4.12
** The alternative model is a multinomial logit model.

In Table 4.22 we also check the possibility whether the categories of the dependent variable should be combined into less categories than three. Again, there is the option for a Likelihood-Ratio Test as well as a Wald test in Table 4.19. The null hypothesis is that all coefficients except intercepts associated with a given pair of alternatives are in fact zero, meaning that the alternatives can be collapsed for a more efficient estimation (Williams, 2015). Overall, both the LR and the Wald Test confirm that none of the categories should be combined. They are significant at the 1 percent level. It can be concluded that the outcomes are distinguishable on the variables included in the model.

The multinomial logit model requires the satisfaction of the independence of irrelevant alternatives (IIA) assumption. The test for IIA is either based on a Hausman test, a Suest-based Hausman test or a Small-Hsiao test, Table 4.23. It should be noted that the tests have been criticized because they are typically inconclusive or even contradictory. The Small-Hsiao test results in different outcomes every time because it splits the sample into two halves and also the Hausman test results in different outcomes if one changes the base category. This is why it is often recommended to instead focus on the Hausman test which uses seemingly unrelated estimation (SUE) as a methodology (Long and Freese, 2005). The Hausman test provides the Chi2>0 and therefore our model meet the asymptotic assumptions of the test. Second, the Suest-based Hausman test provides strong evidence support the independence of irrelevant alternatives in the sample. It cannot reject the null hypothesis at the 5 percent level.

Table 4. 23 Tests of IIA assumption for the alternative model

Outcome	Hausman			Suest-based Hausman		Small-Hsiao		
	chi2	df	P>chi2	chi2	df	chi2	df	P>chi2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
private	-9.838	9	.	26.321	10	4.826	10	0.902
public	-4.956	9	.	12.212	10	14.849	10	0.138
dual practice	1.144	9	0.999	14.633	10	14.185	10	0.165

*Observations=761
*The test of IIA assumption for the result in Table 4.12
** The alternative model is a multinomial logit model.

The result of diagnostic checks and irrelevant independent assumption shows that the alternative model is a good model that can explain the physician's decision on being private, public, or dual practice physician.

4.7 Policy Exploration on salary

The objectives of the policy exploration are to analyse how income intervention might affect the dual practice decision. The first policy is to see how dual practice decision changes after the intervention on primary income. The claim is based on the previous theoretical work and our empirical finding that physicians might want to avoid dual practice and prefer to stay in public sector or private only. The second policy is how dual practice decision will differ after the increasing of public salary. The intervention policy in public sector might easier to implement because the only determinant is the government just by setting the salary level. It will completely different for the private market especially in Indonesia because there are many factors that involve the physician's income in private sector. For example price of the treatment where competitive private treatment fee exists among private practice and private clinics. Our theoretical framework has shown how private sector determines its price treatment and quality level[2]. Using the main model we simulate policy related to public salary and the alternative model to simulate policy relates with primary income. We calculate the predicted probability for each individual, then we apply one policy and then we calculate the percentage of individuals which experiencing the change on the predicted probability.

The policy exploration is using the main model of Model 1 to show the effect of increasing primary income. The simulation uses double increase and five times increase in public salary level. In Table 4.24, the increase of public salary two times from the initial level slightly changes the average predicted probability, even when we classify based on rural and urban location, the figures provide similar conclusion. The double increase in public salary level do change the average predicted probability or in other word, not many physicians change their decisions as they thought that the offer is not worth enough to give the dual practice or private sector. We simulate on higher level of increase in the public salary level. In this case we multiply public salary into five times. The result shows that the average predicted probability changes more substantial different than the initial predicted probability. From Table 4.25, the increase on public salary level attracts more physicians to work in public in urban areas rather than in rural areas.

[2] The theoretical framework on price and quality in private sector is available in Chapter 2. The empirical evidence regarding price of treatment using Indonesian case is available in sub Chapter 4.6.2.

Table 4. 24 The average predicted probability before and after simulation*

Outcomes	The average predicted probability on the initial model	Predicted probability after simulation of double public salary	Predicted probability after simulation in five time multiplication
(1)	(2)	(3)	(4)
Private	0.25	0.25	0.22
Public	0.22	0.23	0.31
Dual practice	0.53	0.52	0.47

Note: Number of observation is 835 physicians. Based on the result in Table 4.8, Column (2) and (3)

Table 4. 25 The average predicted probability in rural and urban area before and after simulation

Outcomes	rural			urban		
	The average predicted probability on the initial model	Predicted probability after simulation of double public salary	Predicted probability after simulation in five time multiplication	The average predicted probability on the initial model	Predicted probability after simulation of double public salary	Predicted probability after simulation in five time multiplicatio n
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Private	0.08	0.08	0.08	0.28	0.27	0.24
Public	0.13	0.13	0.18	0.23	0.25	0.33
Dual practice	0.79	0.78	0.75	0.49	0.48	0.43

Based on the result in Table 4.8, Column (2) and (3)

One consideration by increasing public salary is whether government can afford the increasing salary rate. The Figure 4.4 shows that the physicians mostly attracted into dual practice at the beginning of their career. The data description on the years of experience and number of dual practice physicians shows that most of physicians are doing dual practice at the beginning of the career.

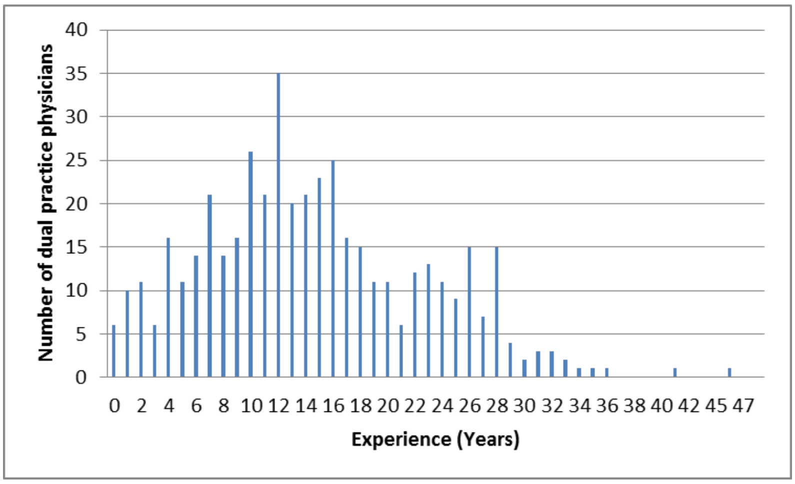


Figure 4. 4: Number of dual practice physicians based on the years of experience

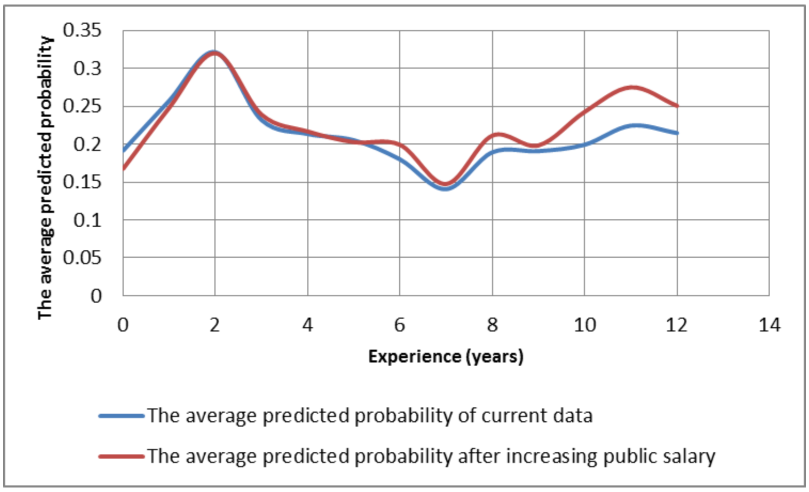


Figure 4. 5: The comparison of average predicted probability before and after the increasing public salary level for the first and second quintile of year experience

To show how specific group of physicians will choose public sector with the increasing public salary, we increase the public salary level into three folds for the physicians that have year experience between zero and twelve years, (Figure 4.5).

The physician group represents the first and second quintile of physician's experience (year) from our data. The fresh graduate physicians react almost the same indicates by the similar predicted probability to work in public sector. Physicians with five or more years of experience have larger probability to work in public compare to the initial level of public salary. These physicians are willing to work as public physicians and not involving in dual practice activity. Using the increasing public salary for certain physicians still attract physician to work in public and avoid being dual practice.

The main findings of the policy exploration imply that it is costly to take physicians only work in public sector, which makes dual practice an attractive strategy for government. The level of public salary might be low but still attract physician to work in public sector due to potential additional income from private sector by implementing dual practice. Increasing public salary is more relevant for physician with higher years of experience. Thus preventing doctors to work only in public facility is more attractive for physicians with 9 to 10 years of experiences.

Primary income describes physician's income from one side of the sector. This will be important to see how physician's decision to involve in dual job activity compares to work only in one sector that measured from the income level. The result from main model and alternative model suggests that physicians are interested in working as a public physician but it decreases after reaching a certain level of income. Physician's choice of sector might change after they have the ability to earn high income in the private sector. The decreasing rate is slow that describes the fact that physician views working in public sector are a solid and proper choice, especially for physician at the beginning of the career. The increasing public salary will decrease the predicted probability of physician working as dual practice. The private sector attracts physician along with the more years of experience. The growing years of experience will decrease the probability of physician working as dual practice. A physician who works in private sector will be more likely to stay working in private sector. It is also supported by the fact that joining public sector usually has to follow more strict rules, such as age limitation in civil servant recruitment and inflexible working hours in public sector. These existing conditions cause the physician to favour more public sector at the beginning of the career. The senior physician already has a stable financial condition and built reputation, hence reduce the urge to move to the public sector as public physician or dual practice.

Table 4. 26 The average predicted probability after simulation

Outcomes	The average predicted probability on the initial model	The average predicted probability after simulation
(1)	(2)	(3)
Private	0.24	0.31
Public	0.22	0.23
Dual practice	0.54	0.46

Note: Number of observations is 761 physicians. This simulation is using result from the alternative model in Table 4.12 (multinomial logit)

The first policy is to multiply the physician's primary income into double than previous main income. In Table 4.26, the double increase of primary income changes the average predicted probability. The outcome of dual practice has lower average predicted probability after simulation. The double increase in primary income provides smaller change in the average predicted probability of physician working in public sector.

The difference physician decision might be from the difference location based on geographical characteristics. The predicted probability before and after simulation into two different groups, rural and urban is in Table 4.27. The classification using rural and urban shows that urban area has higher decrease on the predicted probability physician working as dual practice.

Table 4. 27 The average predicted probability in rural and urban area after simulation

Outcomes	rural area		urban area	
	The average predicted probability on the initial model	Predicted probability after simulation	The average predicted probability on the initial model	Predicted probability after simulation
(1)	(2)	(3)	(4)	(5)
Private	0.08	0.11	0.27	0.34
Public	0.12	0.13	0.23	0.24
Dual practice	0.80	0.76	0.50	0.42

Note: Number of observations is 761 physicians. This simulation is using result from the alternative model in Table 4.12 (multinomial logit)

The policy exploration using the main model and alternative model show that the effect of income to the choice of physician working sector is relatively small although it is positive and significant. Therefore our simulation shows that although public salary has increased five times from the initial value, the change in probability of physician choosing each working sector is less meaningful. When we look back to the data source of IFLS 5, the physician's information is collected by self-enumeration, so that physicians fill the questionnaire by themselves, and the interviewer will collect after that. The data from self-enumeration especially income data is usually under reported. In this case, we are unable to confirm the income information as the data is not linked to other financial data source such as tax report that applied in the study of physician in Norway by Johannessen & Hagen (2014).

4.8 The effect of dual practice and insurance to price analysis

The analysis is to analyze the second purpose of this paper. The discussion is related with the policy implication of dual practice physician and insurance coverage. This part is the empirical evidence as the continuation of the framework that we have already described in Chapter 2. The discussion is on the price effect on the policy implication. It appears here in the same discussion with the physician's decision on choosing working place as part of the supply side in our framework on dual practice study.

Our theoretical framework shows that dual practice existence in health care system functions to lower the price of treatment in private facility. Dual practice allows physician to have additional private practice outside his duty in the public facility. The additional provider affects the patient's demand so that patient has more option to get health care treatment. The competition will be responded by private facility to lower the price. The insurance in other hand will affect in different direction with dual practice. The definition of insurance is a percentage of treatment fees that will be covered by insurance company. The shifting demand between patient choosing between public facility and private facility makes treatment price in private facility is increasing as the insurance coverage is also increasing.

To provide evidence on the relationship between price of private facility, dual practice, and insurance coverage, we directly show the price in private facility effect in the regression form:

$$p_2 = f(Number\ of\ Dual\ Practice\ physician, \%\ of\ population\ with\ insurance, control) \quad \textbf{(4. 21)}$$

We use data from Indonesian Family Life Survey (IFLS) wave 5 in 2014. The survey has a questioner to capture the public and private facility data in the selected survey area. We combine the data with the public community health center; a government owned facility to represent public health care facility. The private facility questionnaire is used to get the information of the treatment fees while the public facility questionnaire is used to approximate the percentage of dual practice physician in particular area. Both facilities mainly provide primary care in the area. The total sample in the survey is 1.597 private facilities consist of private physician practice and clinics. The sample reduction happens along with regression process as there are missing values in from price, insurance, or dual practice data.

We use a particular treatment of treating the wound in the private facility to capture the price information. The price is in Indonesian Rupiah currency. This specific treatment is chosen because this treatment includes a standard care that usually provided in private health care facility. The other practical reason as this treatment has the lowest rate of missing value in the data set. There are other prices of private facility service available from IFLS data, but most of them are severe from having large missing values. To show that price of treating wound is a good measurement in representing the price of private facility, we provide correlation coefficient between price of treating wound and other prices of: first stitching of wounds, changing of wound dressing, blood sugar test, combination between examination, injection, and medicine, and combination between examination and medicine. After clearing out the extreme values and filling the missing values with the average price, the correlation coefficient between price of treating wounds and other prices show positive correlation a relatively modest relation. This is a good sign that the price of treating wound is satisfied enough to represent the price of private facility. The complete result for other correlation coefficients is in Table 4B.13 of the Appendix.

The number of dual practice physician in the area is approximated by the ratio between dual practice physician and total physician in public facilities. The questionnaire in the IFLS is not designed to capture the dual practice activities in Indonesia directly. We get the information on the number of dual practice physician from the public community health center questionnaire. The ratio count in public facility as the data can only identify the dual practice physician in public facilities. The questionnaire on private facilities cannot directly approach the information on dual practice activity because there is no specific question on whether physician also engaged in public facility. The public physician can be differentiated to be a dual practice by filter question on whether the physician working in private practice after public working hour. We sum up the number of dual practice physician and total physician in the same district, region, and province.

Percentage of population with insurance measures the percentage between individual with insurance (any insurance scheme) and the total population in the sample. The insurance schemes in the questionnaire covers the possible insurance schemes in Indonesia, from the public insurance, company insurance, private insurance, and also insurance from government aids. The full options that appeared in the questionnaire are: health insurance from PT ASKES, labor (social) insurance (ASTEK JAMSOSTEK), employer provided health insurance benefit, employer provided clinic, private insurance, saving-related insurance, JAMKESMAS, JAMKESDA, JAMKESSOS, JAMPERSAL, and JKN.

In addition, we use the location identification as a control variable in the regression. We use urban rural identification and Java- Non Java Island as control variables. The urban variable is a dummy variable that has value of one when private facility located in the urban area and zero if it is located in rural area. The java variable equal to one if private facility is located in Java Island and zero if it is located in Non-Java Island. Other control variable is number of people in the area where private facility is located.

We regress between price in private facility, the percentage of dual practice physician in the region, and percentage of an individual with insurance using two level of areas, district level, and region level. The physician dual practice ratio and percentage of an individual with insurance have three kinds of number based on the area scope. From a "kecamatan" (or a district: a group of villages), a "kabupaten" (or region: a group of kecamatan), can be associated with municipal, and a "province" (a group of the region). We provide the result for district and region level.

Table 4. 28 The descriptive statistics for the price analysis

Variables	observation	mean	Standard deviation
(1)	(2)	(3)	(4)
Price	1,418	38,487.7	32,996.0
% dp physician (district)	1,597	.642	.212
% dp physician (region)	1,597	.640	.180
%insured population (district)	1,597	.513	.175
%insured population (region)	1,597	.506	.145

The descriptive statistics in Table 4.28 shows that the number of observation is 1,418 and the price information from private facilities has average price of 38,488 IDR. The price data shows the reduction of the number of observation from 1,597 to 1,418. The missing values around 11%, it means that not all of facilities filled the price information on price of treatment wounds. The percentage of dual practice physician per area using district level and region level are almost the same, around 64%. This means that around 100 public physicians working in public facility in the area, there are 64 of them are actually also dual practice physicians or 64 public physicians have private practice outside their public working place. The percentage of insured population per area using district level and region level data shows similar figure that around 51% of the population has already covered under insurance scheme regardless the insurance type. There are several insurance types available such as private insurance, public insurance, and subsidized insurance.

Table 4. 29 The coefficient estimate using district level data and region level data

Variables	District		Region	
	Coefficient (Std. Error)	p>|t|	Coefficient (Std. Error)	p>|t|
(1)	(2)	(3)	(4)	(5)
Number of dual practice physician	-10053.2 (4271.8)	0.019	-5399.9 (5125.4)	0.292
Percentage population with insurance	19807.7 (5141.2)	0.000	32339.38 (6269.1)	0.000
Cons	3460.2 (4360.2)	0.000	25810.9 (5328.1)	0.000
Number of observations	1418		1418	
F(2,1415)	13.7		17.7	
R-Squared	0.020		0.025	

The first attempt to analyze the relationship between price, dual practice physician, and insurance is by regress the price to dual practice and insurance without control variables using different level of data. We use district and regional level to check the consistency of the data from the imputation process in preparing the data. In general, from Table 4.29, the regression model is significant in explaining the relation between price, the number of dual practice physician, and percentage of the population with insurance. The dual practice physician ratio mostly has a negative sign, although it appears significant only in the regression using district area and median number. The R squared is small indicates that the model needs more variables to explain the price in private facility. We use the district level data and put the control variables. The regression result using control variables is following (Table 4.30).

Table 4. 30 The coefficient estimate with control variables

Variables	Coefficient (Std. Error)	p>|t|
(1)	(2)	(3)
Number of dual practice physician	-2645.5 (4380.4)	0.546
Percentage population with insurance	1044.6 (5489.8)	0.849
Urban	9048.5 (2066.6)	0.000
Java	-2451.0 (1909.0)	0.199
Population	.08 (.01)	0.000
Cons	27261.1 (4355.6)	0.000
Number of observations	1418	
F(2,1415)	13.7	
R-Squared	0.020	

The dual practice variable and insurance variable are both insignificant but provide the same sign as previous result. The increasing of dual practice physician in the system will decrease the price sets in the private facilities. Variable of percentage population with insurance consistently shows positive and significant sign in all regressions. The increasing insurance coverage leads a higher in the price in the private facility. The urban variable indicates that the private facility in urban area has higher price of treatment than rural area. The population coefficient indicates that more population has significant and positive relationship with the price of private treatment.

4.9 Conclusion

Our result suggests that physician prefers to work in one sector only, public or private and not being dual practice. The income and experience variables are important for the physician to decide a choice of being public, private, or dual practice. Physician's location also affect physician to engage in dual practice especially in rural and Non-Java Island as those areas provides more challenges such as less population, lack of facility and transportation difficulties.

The existence of the dual practice in Indonesia initially is a compensation of low salary in public sector. The increasing salary rate indeed reduces the existence of dual practice among public physician. However, the increasing salary mostly attracts the fresh graduate physician and only has a small effect for the senior physician. The growing of private sector is more interesting for a physician to involve in a private facility. It needs higher increase in salary to keep the physician from being dual practice and stay in public. The increasing salary rate can maintain physician to stay in public sector and become potential human resources in the future along with their experiences. The more profitable option is that government works hand in hand with the private sector, rather than competes with the private sector through salary rising to attract physician as it will be costly and harm the available budget.

The physician in urban and Java Island prefer on private sector while rural and non-Java Island is dominated with dual practice physician. The government should pay more attention to strengthening public sector on rural and Non-Java Island, as health provision on these areas depends much on public instead on private. The existing program on provides 1-2 years temporary contract for a fresh graduate physician to work in public facility of remote areas is an excellent approach to continue providing services in the rural and non-Java island. Those areas can be covered by physician services in the short term. The further policy is needed to provide physician availability in the long term. The proposed policy is to increase benefit working in public. Not merely increase the public salary, as this must be deal with the limited budget, but this can be translated into another additional benefit such as the chance to have specialist education in the future.

The implications of our finding to the dual practice policy emphasizes that it will be very costly to have physicians working only in public sector and banning the dual practice. We measure it by calculating how much payment is required to have them moving from dual practice to public sector only. Giving more income or wage is only relevant after physicians have some years of experience and the effect is overall small in magnitude. Physicians are not sensitive to the increasing of public salary can be interpreted that rising the public salary in our case does not compensate for the opportunity loss from being dual practice. The theoretical analysis predicted that an advantage of dual practice is a downward pressure on the price of private provider thus bringing an indirect benefit from dual practice. This seems to be presented in our data. These two facts combined suggest that dual practice is a sensible policy in the context of Indonesia. This policy is difficult to replace in term of physician’s choice by public service only as income increases would have to be quite substantial.

Appendix

Table 3A.1. Summary of previous literature on variables of health care demand

Variables	**Author (year)**	**Definition**	**Significant to healthcare demand?**
Insurance	Akin, Griffin, Guilkey, & Popkin (1986)	Category variable indicates if the individual is covered by health insurance	Insignificant
	Gertler & Van der Gaag (1989)	Individual having insurance or not.	Significant, insurance is important in developing countries.
Income	Akin, Griffin, Guilkey, & Popkin (1986)	assets value which is the value of personal assets-house, lot, furniture, appliances, and vehicles.	Insignificant
	Akin, Guilkey, and Denton, (1995)	wealth (assets) of the household, income of the household (lowest 20%)	Significant
	Sarma (2009)	In term of monthly consumption expenditure	Significant but small in magnitude
Price	Akin, Griffin, Guilkey, & Popkin (1986)	Standard fee schedule, cash prices associated with each service (including visit price, drug cost, and transport cost)	Significant
	Gertler & Van der Gaag (1989)	Medical expenditure	Significant
	Akin, Guilkey, and Denton, (1995)	The prices for outpatient registration	Significant
	Jack (1999)	Medical expenditure	Significant
	Sahn, Younger, & Genicot (2003)	User fees	Significant
	Sarma (2009)	Consist of total medical expenditure, transport and lodging, personal medical appliances, any reimbursement, loss of household income, other expenditure	Significant but small in magnitude
Travel cost	Akin, Griffin, Guilkey, & Popkin (1986)	Transport time, transport cost to health care facilities.	Insignificant

Variables	**Author (year)**	**Definition**	**Significant to healthcare demand?**
	Sarma (2009)	The categorical variable represent the distance of patient from the nearest facility; the availability of bus service in the village	Distance gives negative effect while the bus service availability is a positive determinant to health care demand.
Quality	Akin, Griffin, Guilkey, & Popkin (1986)	Whether outpatients are seen by doctors	Insignificant
	Akin, Guilkey, and Denton, (1995)	Expenditure on care per person in population served, Drug availability (percentage of time available), Physical condition of facility index	Significant
	Sahn (2003)	Adequate/good doctor quality, adequate/good drug, adequate/good environment quality	Significant
Geographical identification and patient characteristics	Akin, Griffin, Guilkey, & Popkin (1986)	Age, Mother's age, sex, baby's sex, education, mother education, seriousness illness, mother at home, number of living children	Insignificant
	Akin, Guilkey, and Denton, (1995)	Gender, education, urban residence, symptoms of the illness, seriousness of the illness	Significant
	Sarma (2009)	Age; Male/Female; Household education; number of children	Significant.
	Gertler & Van der Gaag ()	Education	Education is not significant
	Ichoku and Leibbrandt (2003)	Severity of illness	Significant

Appendix

Table 4A.1. Summary of dual practice physician's motivation

Dual practice motivations	Main results and authors
Hours restriction approach	Number of hours spent in primary job will affect decision to commit in second job (Culler and Bazolli, 1985)
Job complementarities: • Complementary earning • Additional non-pecuniary benefits • New skills and experience	• Low public salary especially in developing countries induce physicians to work in private sector to complement their income, study in Bangladesh (Gruen, Anwar, Begum, Killingsworth, and Normand, 2002) and Cambodia (Soeters and Griffiths, 2003). • One sector offers professional training, improvement, prestige, etc. • Working in private is a chance to add skills and experience (Heineck, 2003).
Professional and institutional factors	• Workload and physical comfort (Askildsen and Homas, 2004). • Professional satisfaction and self-realization that sometimes not offered in primary public job (Macq et al., 2001). • Interaction and influence among physicians in public sector (Eisenberg, 1986).
Personal factors	• Personal characteristics such as sex, age, and family structure affect physician's decision to involve in dual practice (Chawla, 1996). • Evidence in Australian and New Zealand where men physician tend to have private practice compare to women physician (Dent, 2004).
Access alternative facilities, relief from high pressure and low appreciation in public	Private sector run together with public sector provide access for health care treatments. Workload in public sector sometimes not balanced with high appreciation for physician (Humprey and Russel, 2004).

Appendix 4A. Sample process and dual practice identification

Figure 4A. 1 Sample selection process

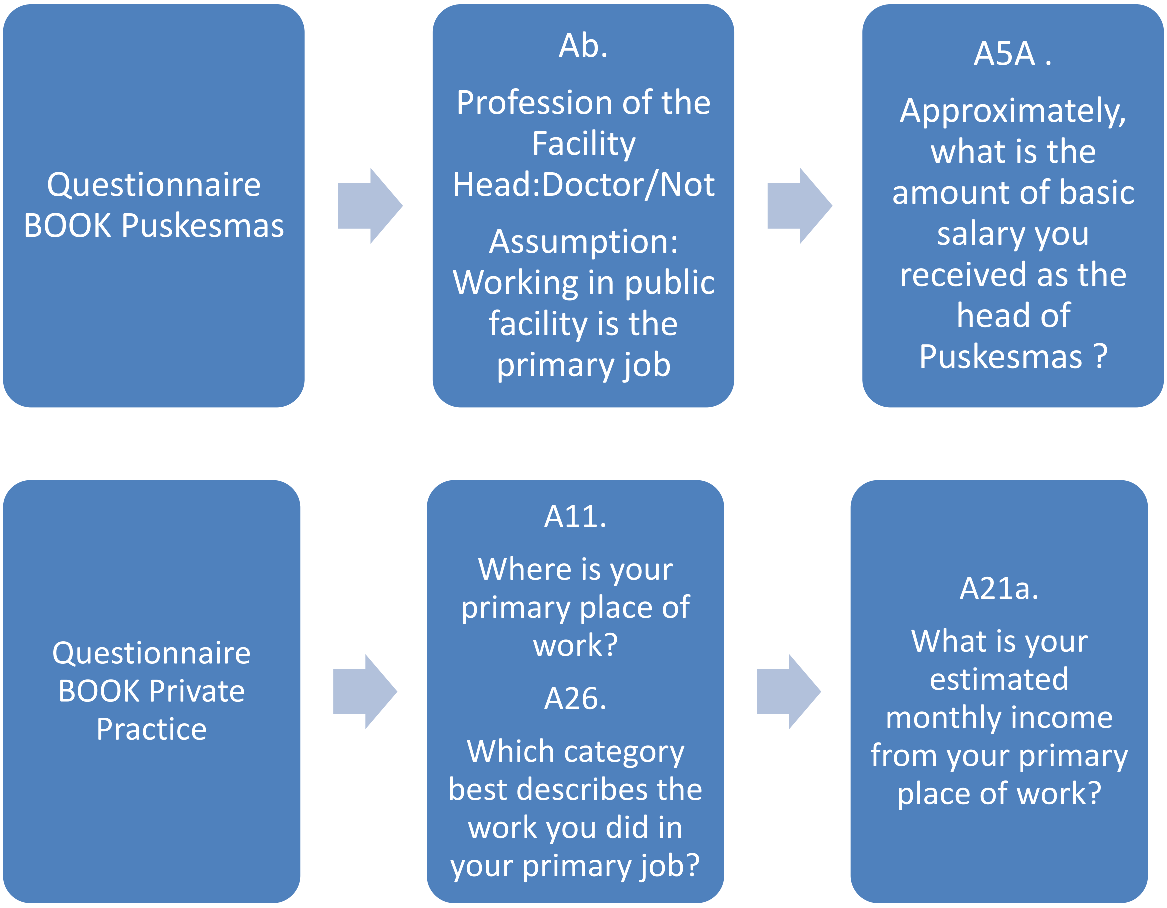


Figure 4A. 2 Validation process of getting main income information

Figure 4A. 3 Validation process of getting salary information of public facility sample

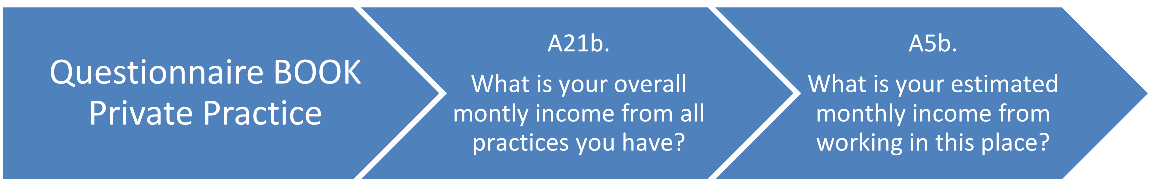


Figure 4A. 4 Validation process of getting total income information of private facility sample

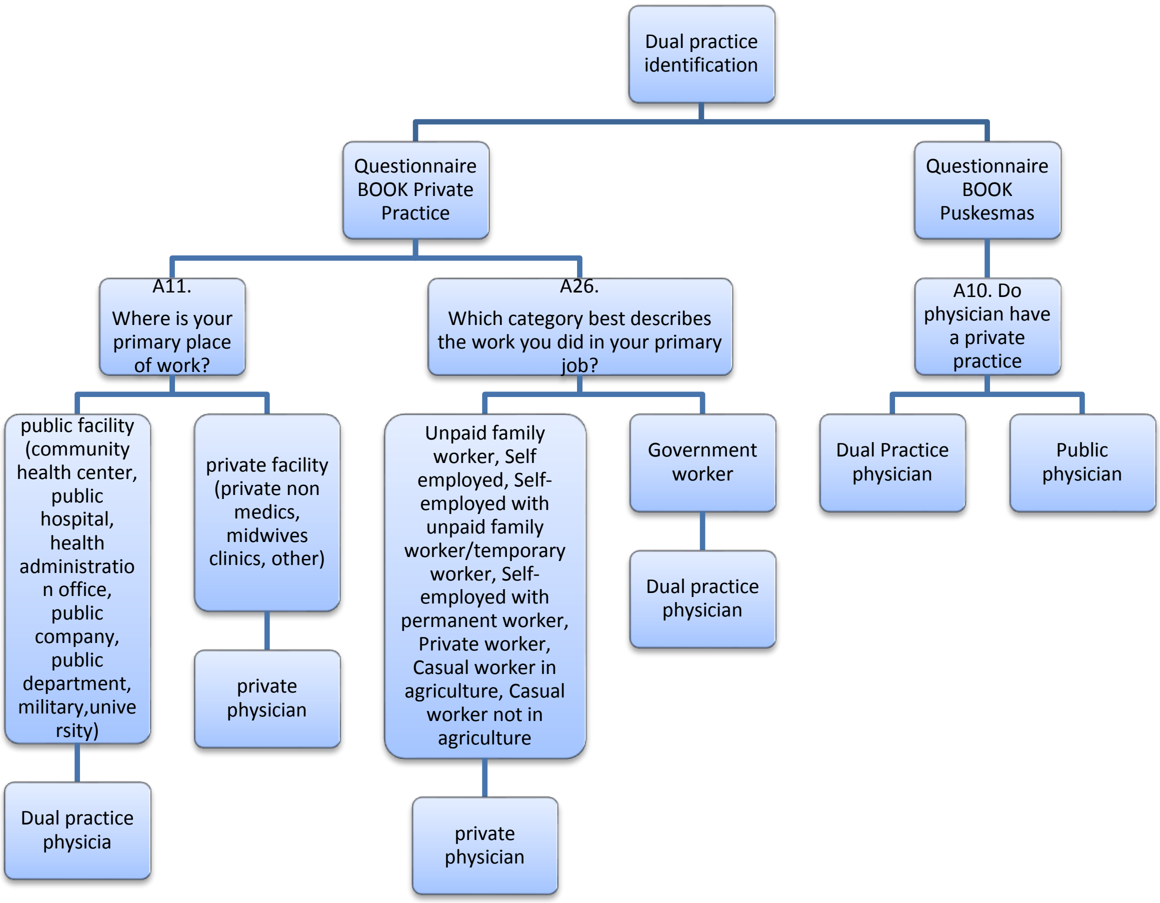


Figure 4A. 5 The dual practice identification process from public facility and private practice

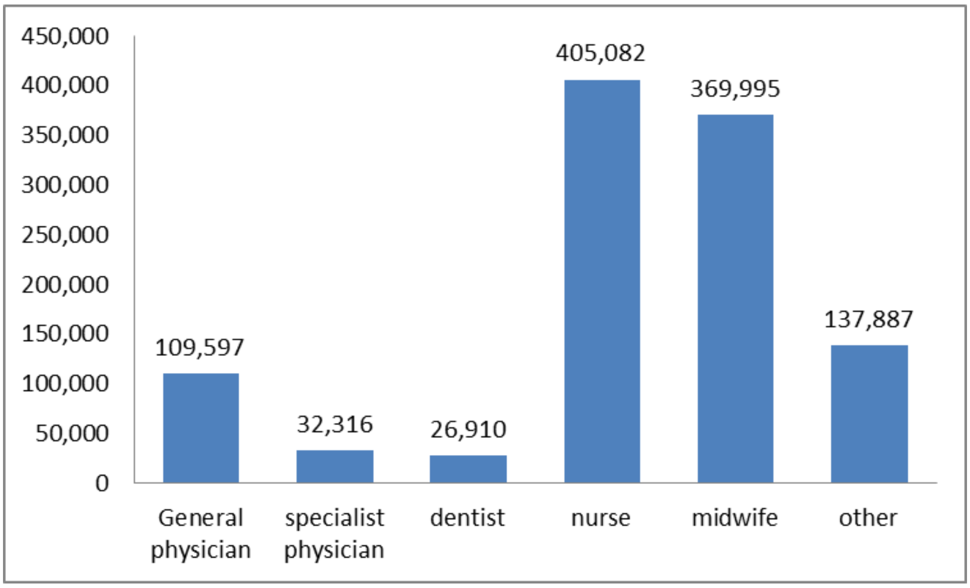


Figure 4A. 6 Number of health care personnel in Indonesia2015

Appendix 4B. Results

Table 4B. 1 The descriptive statistics of physician charactheristics (for the alternative model of multinomial logit

Variables	Number of sample (percentage)
Physician	
Private	185 (24.31)
Public	167 (21.94)
Dual practice	409 (53.75)
Total	761(100)
Education	
Graduated from 5 famous medical school	295 (67.93)
Graduated from other medical school	625 (32.07)
Physician	
Male	427 (56.11)
Female	334 (43.89)
Total	761(100)
Language	
Speaking local language	873 (95.10)
Not speaking local language	45 (4.90)
Java	
Yes	545 (71.62)
No (Non-Java Island)	216 (28.38)
Urban/rural area	
Urban	659 (13.40)
Rural	102 (86.60)
Total	761(100)

Table 4B. 2 The physician experience based on physician choice of working place

Experience (years)	Private physician	Public physician	Dual practice physician	Total
<10	60	45	113	218
10-<20	42	62	190	294
20-<30	36	52	92	180
30-<40	32	8	12	52
40++	15	-	2	17
Total	185	167	409	761

Table 4B. 3 The Variables and physician choice

Variables	Number of Physicians (percentage) Private	Public	Dual Practice	TOTAL (percentage)
Sex				
Male	110(32.94)	21(6.29)	203(60.78)	334(100)
Female	75(17.56)	146(34.19)	206(48.24)	427(100)
Education				
Graduated from 5 famous medical school	53(21.54)	63(25.61)	130(52.84)	246(100)
Graduated from other medical school	132(25.63)	104(20.19)	279(54.17)	515(100)
Language				
Speaking local language	177(24.41)	155(21.38)	393(54.21)	725(100)
Not speaking local language	8(2.23)	12(33.34)	16(44.43)	36(100)
Java				
Yes	149(27.34)	131(24.04)	265(48.62)	545(100)
No (Non-Java Island)	36(16.67)	36(16.67)	144(66.66)	216(100)
Rural/urban area				
Rural	8(7.84)	12(11.76)	82(80.39)	102(100)
Urban	177(26.86)	155(23.52)	327(49.62)	659(100)

Table 4B. 4 The physician experience based on physician choice of working place

Experience (years)	Private physician	Public physician	Dual practice physician	Total
Below average(15.8)	88(20.80)	91(21.51)	244(57.68)	423
Above average (15.8)	97(28.70)	76(22.49)	165(48.82)	338
Total	185	167	409	761

Table 4B. 5 The physician main income based on physician choice of working place

Mainincome (1000 IDR)	Private physician	Public physician	Dual practice physician	Total
Below average(8.15)	100(18.18)	111(20.18)	339(61.64)	550
Above average (8.15)	85(40.28)	56(26.54)	70(33.18)	211
Total	185	167	409	761

Table 4B. 6 The descriptive statistics of the sample regression

Variable	obs	Mean	Std.Dev	Min	Max
Main income	761	8.325955	14.81796	.54	300
Private	185	13.71703	27.8844	.7	300
Public	167	8.046233	5.984101	.54	39
Dual practice	409	6.001664	5.015586	1	60
Experience	761	15.82523	9.92112	0	48
Percentage of elderly	761	5.240382	2.201292	2.209758	13.43876
Physician ratio	761	8071.52	14573.13	498.5989	182460

Table 4B. 7 Variable description from public facility sample

Variables	Number of sample (percentage)
Physician	
Public	218 (40.37)
Dual practice	322 (59.63)
Total	540(100)
Education	
Graduated from 5 famous medical school	361 (66.85)
Graduated from other medical school	179 (33.15)
Total	
Physician	
Male	160 (29.63)
Female	380 (70.37)
Total	540 (100)
Language	
Speaking local language	511 (94.98)
Not speaking local language	27 (5.02)
Total	540(100)
Java	
Yes	400 (74.07)
No (Non-Java Island)	140 (25.93)
Total	540(100)
Urban/rural area	
Urban	461 (85.37)
Rural	79 (14.63)
Total	540(100)

Table 4B. 8 The descriptive statistics from public facility sample

Variable	obs	Mean	Std.Dev	Min	Max
Salary	468	6.609279	4.900208	.54	39
Public	188	7.983755	6.078888	.54	39
Dual practice	280	5.686417	3.646472	1	26
Experience	484	14.91942	7.983661	0	33
Percentage of elderly	539	5.189271	2.177596	2.165087	13.43876
Physician ratio	520	8606.506	15970.54	498.5989	182460

Table 4B. 9 Logit Regression Result from public facility sample

Variable	Coefficient (Standard Errors)
1.male	1.218***
	(0.283)
1.educ1	-0.151
	(0.256)
1.language	0.804
	(0.497)
1.urban	-0.267
	(0.392)
1.java	-0.547
	(0.290)
experience	0.0175
	(0.0147)
Percentage of elderly	0.167**
	(0.0637)
Physician ratio	0.0000249*
	(0.0000124)
Public salary	-0.0497
	(0.0263)
_cons	-0.911
	(0.743)
N	419

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4B. 10 Variable description from private facility sample

Variables	Number of sample (percentage)
Physician	
Private	216 (56.84)
Dual practice	164 (43.16)
Total	380(100)
Education	
Graduated from 5 famous medical school	264 (69.47)
Graduated from other medical school	116 (30.53)
	380(100)
Physician	
Male	238 (62.63)
Female	142 (37.37)
Total	380(100)
Language	
Speaking local language	362 (95.26)
Not speaking local language	18 (4.74)
	380(100)
Java	
Yes	273 (71.84)
No (Non-Java Island)	107 (28.16)
	380(100)
Urban/rural area	
Urban	336 (88.42)
Rural	44 (11.58)
Total	380(100)

Table 4B. 11 The descriptive statistics of from private facility sample

Variable	obs	Mean	Std.Dev	Min	Max
Total income	349	15.10747	16.01678	.175	120
Private					
Public					
Dual practice					
Experience	379	17.15831	11.93839	0	48
Percentage of elderly	379	5.36578	2.241079	2.413653	13.43876
Physician ratio	372	6981.445	10352.75	498.5989	77149

Table 4B. 12 Parameter Estimates of Multinomial logit

Variables	private vs dual practice	public vs dual practice
(1)	(2)	(3)
1.male	0.423*	-1.805***
	(0.198)	(0.263)
1.education	-0.656**	0.173
	(0.229)	(0.233)
1.language	-0.439	-0.718
	(0.488)	(0.446)
1.urban	1.442***	0.225
	(0.435)	(0.373)
1.Java	0.908***	0.702**
	(0.239)	(0.253)
Main income	0.0676***	0.0399*
	(0.0160)	(0.0183)
Years of experience	0.0259**	0.00303
	(0.00965)	(0.0112)
Percentage of elder population	-0.0795	-0.227***
	(0.0486)	(0.0569)
Physician ratio	-0.0000144	-0.0000224*
	(0.00000935)	(0.0000110)
_cons	-2.789***	0.532
	(0.705)	(0.635)
N	761	
Pseudo R-Square	0.16	
LR chi2 (18)	246.05	
Prob>chi2	0.00	

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4B. 12 Parameter estimates of the main model (Model 1) with interaction term

Variable	m1	m2	m3	m4
income	.04012618**	.0698271**	.05447978**	.04982905
	.02040476	.03173985	.01669381	.03858715
inc*exp_pub	2.328e-08			2.278e-08
	2.181e-08			2.214e-08
inc*exp_pv	1.157e-08			1.151e-08
	2.732e-08			2.772e-08
Income*urban		-1.343e-08		-1.235e-08
		3.306e-08		3.410e-08
Income*java			4.293e-09	2.640e-09
			1.965e-08	2.031e-08
public				
male	-1.5872705***	-1.586829***	-1.5843996***	-1.5901982***
	.24889185	.24888757	.24871047	.24906528
educ1	.12377818	.12940289	.12581078	.1257502
	.22373704	.22388374	.22384352	.2239666
language	-.52344896	-.51795016	-.52244414	-.52348613
	.42626621	.42541828	.42471167	.42691721
urban	-.06268269	-.14114683	-.03987892	-.15130649
	.35836853	.4304954	.35776326	.43452047
java	.61557522**	.61520374**	.64843381**	.63130403**
	.24528016	.24511086	.28173839	.28306892
experience	.00707012	.00521433	.00526234	.0070784
	.01145491	.0107015	.01070811	.01146439
&elderly	-.25543855***	-.2592304***	-.25775646***	-.25634468***
	.05407369	.05402392	.05391889	.05422363
phyratio	-.00002399**	-.00002391**	-.0000242**	-.00002371**
	.0000114	.00001146	.00001146	.00001141
_cons	1.4095316**	1.5217691**	1.4013899**	1.4823639**
	.60934835	.649221	.61415856	.6597563
private				
male	.58928011***	.59438829**	.59578165**	.58530148**
	.19103092	.19073398	.1908887	.19138358
educ1	-.59264467**	-.58599057**	-.59085433**	-.58994494**
	.21707985	.21695519	.21706116	.21730186
language	-.12148991	-.12780311	-.12702351	-.1216492
	.48233168	.48024795	.4805407	.4824248
urban	1.2732822**	1.2365866**	1.279213**	1.2374847**
	.41519344	.4273492	.41466877	.42980758
java	.99896502***	1.0069926***	1.0270319***	1.0051392***
	.234495	.23435622	.24526899	.24609072
experience	.04084701	.0405184	.04068473	.04079189
	.0096283	.00925102	.00925163	.00962134
&elderly	-.13959292**	-.14288442**	-.14239788**	-.13976419**
	.04741057	.04716901	.04719512	.04742712
phyratio	-.00001349	-.00001347	-.00001348	-.00001336
	9.009e-06	8.970e-06	8.985e-06	9.011e-06
_cons	-2.2348192**	-2.1917056**	-2.2472684**	-2.2049824**
	.68272793	.68775135	.68290808	.69339386
Statistics				
N	2505	2505	2505	2505
LL	-697.07482	-697.6339	-697.69922	-696.99974

* p<.1; ** p<.05; *** p<.001; b/se

Table 4B. 13 Summary statistics and correlation among the price data (Sub Chapter 4.9)

Variable	Missing	Total	Percent Missing
price6	174	1,597	10.90
price5	860	1,597	53.85
price4	465	1,597	29.12
price3	659	1,597	41.26
price2	523	1,597	32.75
price1	619	1,597	38.76

Variable	Obs	Mean	Std. Dev.	Min	Max
price6	1597	38487.66	31090.65	5000	700000
price1	1597	36882.7	30327.57	1000	300000
price2	1597	23668.85	14322.03	2000	200000
price3	1597	18238.56	5467.197	4554	80000
price4	1597	46423.69	30862.35	5000	500000
price5	1597	27413.04	8154.514	10000	200000

	price6	price1	price2	price3	price4	price5
price6	1.0000					
price1	0.2349	1.0000				
price2	0.3446	0.3112	1.0000			
price3	0.2274	0.0566	0.1023	1.0000		
price4	0.8473	0.2056	0.3305	0.2576	1.0000	
price5	0.1879	0.0808	0.0902	0.4369	0.1859	1.0000

Note: price6=Treating wound; price1=first stitching of wounds, ; price2=changing of wound dressing, ; price3=blood sugar test, ; price4=combination between examination, injection, and medicine, price5= combination between examination and medicine.

Appendix 4C Estimation process to get alternative income in Model 2 (after correcting endogeneity)

Table 4C. 1. Coefficients of alternative income from linear regression (public physician)

```
--------------------------
    Variable | linreg_pub
-------------+-------------
  experience |  156616.42
             |  31874.781
       urban |  1266073.9
             |  647887.28
        java |    1078308
             |  563659.79
Workinghours |  60142.311
             |  20138.498
       _cons |  1056473.8
             |  794776.27
-------------+-------------
Number of obs =      319
F(  4,   314) =    15.62
Prob > F      =   0.0000
R-squared     =   0.1660
Adj R-squared =   0.1553
MSE           =  4.3e+06
---------------------------
legend: b/se
```

Table 4C. 2. Coefficients of alternative income from linear regression (private physician)

```
---------------------------
    Variable | linear_pv
-------------+-------------
        Male |  .15762359
             |  .08940387
  experience | -.00788891
             |  .00366458
        java | -.22768219
             |  .09281511
 main income |  .61489379
             |  .05002223
       _cons |  6.7042457
             |  .77143179
-------------+-------------
Number of obs =      345
F(  4,   340) =    41.35
Prob > F      =   0.0000
R-squared     =   0.3272
Adj R-squared =   0.3193
Root MSE      =   .78017
---------------------------
legend: b/se
```

Table 4C. 3. Coefficients of alternative income from linear regression (dual practice physician) from public physician data

```
---------------------------
    Variable | linreg_d~b
-------------+-------------
 experience  |  138751.56
             |  25079.634
       urban |  1392283.1
             |  570861.25
incpv_practi |  .96518071
             |  .02606805
       _cons |    3517709
             |  670840.42
-------------+-------------
Number of obs =     490
F(  3,   486) =  476.43
Prob > F      =  0.0000
R-squared     =  0.7463
Adj R-squared =  0.7447
Root MSE      =  4.4e+06
---------------------------
legend: b/se
```

Table 4C. 4. Coefficients of alternative income from linear regression (dual practice physician) from private physician data

```
---------------------------
    Variable | leardp~v
-------------+-------------
        male |  .24777962
             |  .08142654
      dualpr |   .2404429
             |  .07941993
 inc_1pvprct |  .23203713
             |  .02184831
       _cons |  12.201636
             |  .35740162
-------------+-------------
Number of obs =     378
F(  3,   374) =   46.43
Prob > F      =  0.0000
R-squared     =  0.2714
Adj R-squared =  0.2655
Root MSE      =  .76274
---------------------------
legend: b/se
```

Estimation process to get alternative income in Model 2 (after correcting endogeneity)

Table 4C. 5. Coefficients of alternative income from endogenous switching regression

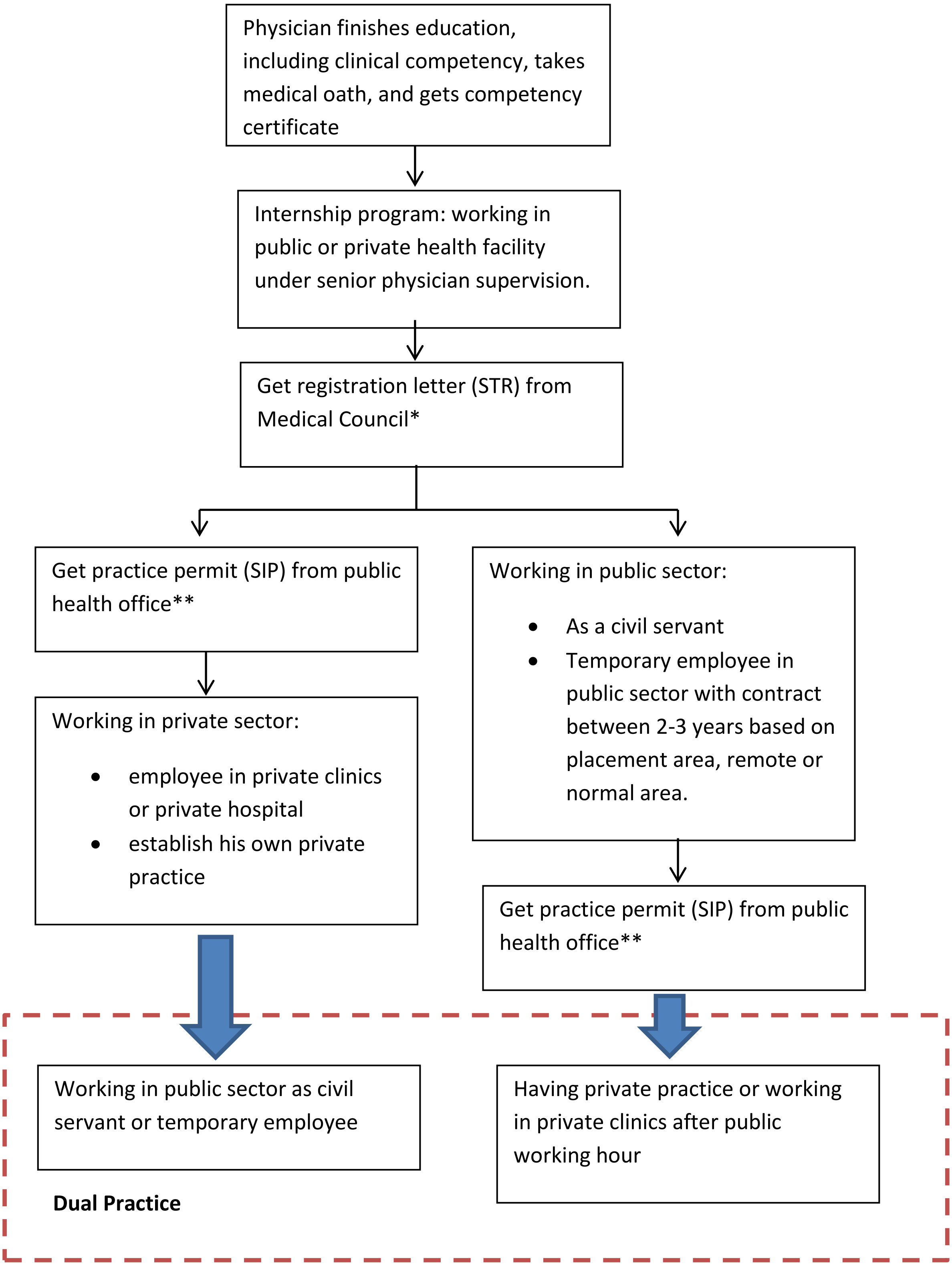
```
Variable     |    Coefficient
                   se
-------------+-------------
Public physician income

        male |  .23037007
             |  .09295455
       urban |  -.2056807
             |  .12094184
        java | -.16722221
             |  .09545603
  experience | -.00960023
             |   .0057528
       _cons |  16.155567
             |  .13407877
-------------+-------------
Income of private physician

        male |  .15852128
             |  .16002977
       urban | -1.0446692
             |  .33565426
        java | -.20793661
             |   .1884005
  experience | -.01824297
             |  .01099541
       _cons |  18.666632
             |  .66248898
-------------+-------------
-------------+-------------
Statistics   |
           N |        821
          ll |  -1468.656
---------------------------
```

Appendix 4D Physician decision diagram

This diagram visualizes the process of the physician choosing working sector, only for a physician who takes a career in the clinical path:



* Registration letter (STR) is valid for five years and can be renewed after.

** Practice Permit (SIP) is valid for five years, each physician will get maximum three practice permits, and each permit is valid for one practice only. This regulation limits number of practice by physician to maintenance the quality

Chapter 5

Conclusion

This thesis aims to understand the dual practice aspects in health care system. The section provides a summary of the primary results, policy recommendations and suggestions for future research. We also conclude the broad overview of dual practice role in health care system. Our empirical study on dual practice is divided into two components, the first one is demand side which appears in Chapter 3 and the second one is supply side which available in Chapter 4.

First, a theoretical framework on the relationship between patient's decision on health facility and physician's working choice on dual practice was developed in Chapter 2. The model uses insurance scheme as a comparison with dual practice policy as the same tools in increasing health care access of population. The model shows that price in private sector is following the price in public set by government. The quality of treatment will follow the increase or decrease of the price. Dual practice existence will lower the price in private, as it allows more physicians to participate in the dual practice activities; it means more option for patient to choose health care facility. The model has testable implications to the total welfare of health care system in the long run and short run. The former refers to the welfare effect where all agents adjust equilibrium state after dual practice or more insurance is allowed after the policy shock. The short run is defined as situation prior to any price adjustment. The dual practice policy might have higher or lower total welfare compare to insurance policy and the leading cause of the difference lies on the demand switching when patient change the health care facility between public or private facility. After the theory framework being laid down, its implications are taken to the data using the Indonesian experience.

Chapter three concentrates on the demand side of the dual practice physicians. The outpatient health care demand framework is used to explain how dual practice influences people deciding their health care facility: private, public, or non-physicians treatment (include here is nurse practice, midwife practice, and traditional healer). Allowing dual practice in the system is one of the government efforts to increase health care utilization by providing more health care services for the people. On the other hand, insurance is another tools increasing health care coverage by relieving financial barrier. Comparing between two policies, subsidizing insurance has more significant impact on changing individual choice from non-physician health care facility to private or public health care facility. The more health care services available in the area do not necessarily imply that people can easily get health care treatment. Price of the treatment and non-monetary factors such as travel cost has significant influence for individual to keep visiting non-physician health care facility. The insurance has direct affect to the individual decision on health care treatment because insurance benefit will be perceived by the recipient only. The dual practice seems to have smaller effect on individual level but actually it provides larger impact in community level because more people will be exposed with the presence of more dual practice physicians in the system. Quality aspect is less significant for individual when choosing between public or private facility. The insignificant of quality components explains that most of quality components are not observe by health care user. Patient priority is on getting treatment first rather than choosing based on quality criteria. The geographic characteristics shows that health care demand is differentiate based on the location. Population in rural and outside Java Island still rely on non-physician health care facility while population living in urban and Java Island choose to visit private and public health care facility.

Chapter four analyses the dual practice physician from the supply side that consists of two aspects. The first one is the direct effects of physician choices of dual practice, private sector, and public sector. The second is the indirect effects on equilibrium prices of private sector from dual practice existence and insurance coverage. Income becomes essential factor that driven physicians involving in dual practice activity. Physicians decide on dual practice as a response to potential health care demand and physician availability. In the area where more elderly population that can be referred to more potential health care demand and number physician is low, the physicians tend to work as dual practice. In line with this results is that physicians in urban and Java island is less likely being dual practitioners contrast with the physicians in rural and Non-Java Island that more likely to engage in dual practice. The equilibrium price of treatment shows that dual practice existence is pressing down the price of treatment thus creates indirect benefit of the existing of dual practice physician in health care system while the insurance coverage is boosting the price. Both conclusions are in line with our finding in theoretical part.

Figure 5.1 summarizes the overview of dual practice physician in demand and supply side. The dual practice physician affects demand of health care by slightly reducing demand in private facility. The empirical evidence shows that dual practice physician in health care system influences patient's choice between public facility and private facility but has small effect on driving individual from non-physician facility (midwife, nurse, and traditional healer) to public or private facility. In the supply side, physician's main motivation from being a dual practice physician is additional income motive. Allowing dual practice in health care system is an additional benefit that can be used to attract physician staying in public sector. Without dual practice in the system, it will be very costly for health authority to set a competitive public salary in order to keep physician working in public sector.

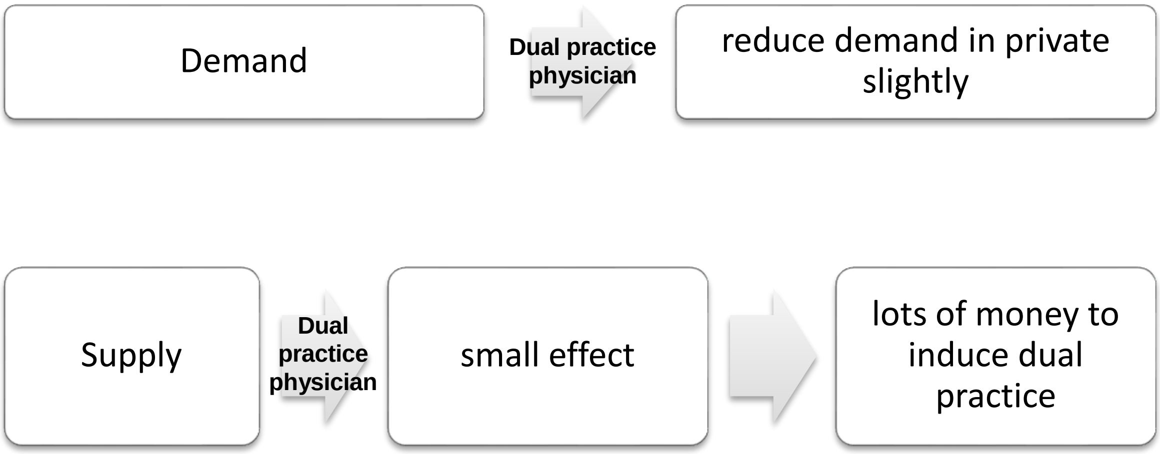


Figure 5.1 Overview of dual practice physician in demand and supply

Indonesia has been regulated dual practice physician since 1970 by allowing public physician to work in private sector. The purpose of the regulation is to provide access to health care for the population when the health care resources were limited. In the recent situation where number of physicians is increasing, the policy of dual practice is in call to adapt into different direction. Increasing health care access can be achieved by providing more access to health care insurance. Indonesian government should increase the insurance ownership through subsidizing scheme or self-participation. Having insurance is directly affected the individual health care demand compare to providing more dual practice. Indonesian government is still developing a national health insurance system under national health care security (BPJS Kesehatan), by encouraging people to voluntarily participate in the insurance scheme and subsidize insurance premium for the poor group. The infrastructure development such as building a good road to access health care facility might be a direct influence to health care access as our result shows that non-monetary cost is essential in health care demand. Regarding dual practice policy in Indonesia, physicians are shown to highly value this practice with additional income as main motive. Dual practice becomes a sensible policy in Indonesia to ensure the services in public sector. Banning dual practice and lets health care services been provided only by private sector and public sector will increase the price in private sector that potentially creates another barrier to health access. A different policy on dual practice might be applied by recognizing different situation in specific areas in Indonesia. The classification area based on rural-urban and Java – Non Java Island has shown that the difference condition of health care access does exist. The dual practice might be allowed in the area where there are still potential demand of health care, with low number of physicians, a specification that refers to rural and non-java island characteristics. While in the area where private sector is well developed and supported with high number of physicians, the dual practice activity might be strictly limited. Dual practice existence functions in lowering the price of treatment in private sector, thus the policy also brings more benefit than harm particularly from patient's perspective.

Our empirical analysis identifies dual practice physician using survey data that has many limitations such as it focuses only on primary health care provider and limited information on physician as the survey is not specifically observing physicians. Dual practice physician can be found in any level of health care providers, different kind of physician specialities, and also common practice among health care personnel other than physician, such as nurse and midwifes. It is important to analyse dual practice aspect on these particular case in the future. Some suggestions regarding Indonesian case, the dual practice physician data can be traced back from health administration office in regional level. It is crucial to report dual practice physician regularly into national scale as any other physician data so that can be use in monitoring process of delivering health care.

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